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CONTENTS:

	PAGE
The Growth of Polyphase Systems	689
The E.M.F. of Alternators on Open Circuit (*illus.*) (*continued*)	691
The Continuous Current Arc (*illustrated*)	694
The Burgdorf-Thun Polyphase Electric Railway (*illustrated*) (*continued*)	695
Correspondence:—	
New Constant Potential Continuous Current Transformer (*illustrated*)	697
The Largest Motor-Generator Plant	697
Legal	697
Business Notes	699
Electrical Development Schemes in India (*illustrated*) ...	705
The Electricity Works of Chèvres (Geneva) (*illus.*) (*continued*)	708
The Works of Ludw. Loewe & Co., Berlin (*illus.*) (*continued*)	709
Rochdale Electricity Works (*illustrated*)	710
The Limitations of Municipal Enterprise	711
Supply Station Accounts	718
City Notes	718
Traffic Receipts	720
Stocks and Shares	720
Share List of Electrical Companies	721
Market Quotations	722
The Production of High Temperatures	723
Systems of Current Distribution on Tramways...	723
Physical Society	724
Electricity Supply in Small Towns	724
The Coal Question in England (*illustrated*)	725
Current Specifications.—XXXIV.	726
New Patents	727
Abstracts of Published Specifications	727

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THE GROWTH OF POLYPHASE SYSTEMS.

SOME reference has been made in these columns to the increase in electricity works employing polyphase generation. The system, however, has been adopted for reasons which differ somewhat from those that account for its popularity on the Continent. The great expansion of three-phase work abroad was due in a great measure to the necessity of transmitting power over considerable distances, but having thus transmitted the required power it was considered more desirable to actually use this current for motors than to interpose any transforming device, and the results that have been achieved go far to justify such an arrangement. In this country, however, the advantages of polyphase working are being utilised chiefly for transmission purposes, and but few attempts are being made to utilise polyphase motors; motor-generators or rotary converters being employed in conjunction with a direct current system of supply.

It is not, of course, very surprising that such companies as those in London which have been so closely identified with continuous current supply should still seek to continue as far as possible on the same lines.

Moreover, there seems to be little reason to doubt that the arrangement of polyphase generation and conversion to direct current will be attended with considerable success. One has heard so much concerning the rapid extension of three-phase work on the Continent that it is a little surprising to find that during the last 12 months there has been no further remarkable increase of polyphase systems, at any rate, in Germany; and some little time ago one of the German technical papers published some striking and instructive figures showing the position which polyphase work occupies at the present time as regards public supply works. During 12 months ending March 1st, 1900, 163 new works were opened, making a total of 652. In the previous 12 months there had been quite a remarkable increase in the number of three-phase stations—in round numbers, the increase was over 100 per cent., but during the year under review the number of three-phase stations had increased only from 33 to 39, and the capacity from 29,715 KW. to 35,150 KW., equivalent to 18·3 per cent.

On the other hand, direct current is actually used in more than 80 per cent. of all the electricity works, their capacity being 53·8 per cent. of the total, which figures show a very slight decrease as compared with the previous 12 months.

The number and capacity of single-phase and three-phase alternating plants have increased, as we have shown, only to a slight extent, but there is a very marked increase in the number and capacity of stations with mixed systems in which both direct and alternating currents are generated, or in which alternating current is used for transmission and direct current

D

for distribution. In 42 stations, against 33 in 1899, single-phase and two-phase currents are used, and their capacity has increased to 21,573 KW., from 17,826 KW. in 1899. The number of combined three-phase and direct current stations has increased from 22 to 38; their capacity from 25,970 KW. to 46,608 KW. The number of combined single alternating and direct current stations has increased from five to six, and the capacity from 1,011 to 1,700 KW. In two stations having a joint capacity of 790 KW., the monocyclic system is used. Steam is used exclusively in 58·6 per cent. of all stations, and the capacity of these works is 76·5 per cent. of the total capacity of all stations.

Water-power is used exclusively in 11·4 per cent. of all stations, with a capacity of 8·2 per cent. of the total capacity of all stations. Among the 74 water-power plants is the largest electric power station in Germany, that at Rheinfelden, which has a capacity of 12,000 KW. In 144 stations with 26,674 KW. capacity, both water-power and steam are used. The number of stations in which the prime motors are driven by gas has increased from 21 to 29, but their capacity is still only 1 per cent. of all stations; 306 stations have a capacity of 100 KW., or less; 249 stations between 101 KW. and 500 KW.; 31 stations between 501 KW. and 1,000 KW.; 29 between 1,001 KW. and 2,000 KW.; 17 between 2,001 KW. and 5,000 KW.; and six having a capacity greater than 5,000 KW.

Private companies own 463 of the works, while 166 are worked by municipalities.

Among the direct-current stations 93·1 per cent. use storage batteries in conjunction with their generating machinery.

These figures must be of the greatest interest to English engineers, and if any conclusions can be drawn from them, they would be to the effect that three-phase works in which three-phase is actually employed in distribution are not very common, and in spite of a somewhat remarkable impetus given to these works in the year 1899, the total capacity is a good deal less than that of the stations in which three-phase currents are generated, but direct current distributed. As we have shown, the capacity in KW. of combined three-phase and direct stations has increased very considerably, and certainly has advanced at a much greater rate than that of plain three-phase works, for while combined stations have increased their capacity from 25,970 to 46,808 KW., the three-phase have increased their capacity from 29,715 to 35,150 KW. These figures would show that the engineers in this country who have adopted a combined arrangement of three-phase and direct current have ample justification for the course they have adopted, if we can take German experience to mean anything.

Nor can it be argued that combined arrangements in this country have been merely dictated by the desire to obtain direct currents for tramway purposes; for, on the contrary, the largest schemes which are being carried out have been rather to obtain the benefits of economical transmission over wide areas for lighting and power purposes.

No one could for a moment deny the advance in electric distribution that has been created by the development of three-phase machinery, but one has a perfect right to resent any statements which seek to decry direct current plant as obsolete. We are afraid that persons who have three-phase plant to push are a little too ready to seize upon the commutator and brushes of a direct current motor as sources of trouble, because there are many instances within our own knowledge where such machinery has run for weeks together without any examination. The direct current motors which are being used at the present moment are nearly always made with a fixed lead, and as they are generally provided with self-oiling bearings, they can be relied upon to run for a considerable period without requiring the slightest attention. As we have pointed out on more than one occasion, three-phase plant is being erected in this country in conjunction with sub-stations where rotary converters transform the current into direct, so that it may be used for traction purposes. We do not say that the schemes which are being carried out are not justified, but there is a danger lest the desire to put in three-phase plant should be carried a little too far. There are in America an immense number of tramways on which polyphase transmission is being employed, but it has been an open secret that many of them were by no means justified in adopting such a system.

This being the case, therefore, it would be just as well for engineers on this side of the Atlantic to bear in mind some remarks which were recently made by Prof. Louis Bell on the subject of three-phase transmission for railway work. One need hardly say that Prof. Louis Bell has been, and is, probably the most ardent champion of three-phase work in America, and if he considers it advisable to advocate greater caution in polyphase work, we may be sure that it is worth listening to. In reviewing the application of electricity for railway work, Prof. Bell, in the *Street Railway Journal*, states that he considers it his duty to sound a note of warning—a warning not directed against power transmission to rotaries, but against making a fetish of any method, however intrinsically useful. He says that many of the roads are transmitting power wisely and economically, but on the other hand, there is little doubt that some are wasting their substance fruitlessly in zealous endeavours to follow the latest fashion.

He goes on to say that in point of solemn fact it is sound engineering to transmit power only when such transmission has a logical economic reason for existence. Every such plant of course wastes power in the transformations necessary for its operation, and must show due cause therefor in an ultimate saving, or stand condemned. It is worth while quoting the remainder of the Professor's remarks, which are as follows :—

> In the ordinary use of rotary converters there are to be encountered the aggregated losses in the transformers, the lines, and the rotaries themselves. In these are consumed under ordinary conditions of load from 20 per cent. to 25 per cent. of the energy input. This loss is irretrievable, and must in some way be compensated if an economic result is to be attained. For every 75 KW. to 80 KW. delivered by the rotaries 100 KW. must be delivered at the generators, and in addition one must buy and instal transformers and rotaries nearly equal in output to the main generators, besides installing the transmission line itself.
>
> That is, to deliver 75 KW. or 80 KW. to the lines, one must have a rotary converter of that capacity, transformers for the same, and a 100-KW. polyphase generator at the other end of the line. If one can drive that generator by cheap water-power, the outlook is generally comforting, but when it is deliberately proposed to drive it by steam-power, there must be a truly prodigious saving somewhere to offset the necessary and unavoidable losses. If one is dealing with 10,000 KW., instead of 100, the need of showing a saving is by so much the more imperative. Now, it is undoubtedly true that power can be generated much more cheaply on a large scale than on a small one, and in this fact lies the key to the situation; but unless the saving is in the neighbourhood of 25 per cent. or 30 per cent., there is a hard outlook for economy in using rotaries, and the bigger the system the more difficult is it to show such a saving. In considering the application of transmission methods on a large scale, a good preliminary step is to consider the effect on the economy of a great station of merely putting up a heavy partition wall dividing the station into two equal and symmetrical parts, and forbidding employés to cross from one to the other upon any pretext, without an hour's notice of their intention. Unless the total cost of the year's output would be increased at least 25 per cent. by this simple change, sufficient reason for the use of rotaries rather than distributed stations will have to be looked for with a search warrant. In rare instances some one site for a station may have great natural advantages, and lead to economic results that could not otherwise be approached, but it is not safe to jump at such a conclusion or to accept it without heavy preponderance of evidence, particularly in view of the fact that even sub-stations require costly space and considerable attendance. If, in the course of events, it becomes generally feasible to use alternating motors for traction purposes, the case will resolve itself into a simple transmission problem, and a favourable solution will not be difficult to reach. At present, as I have endeavoured to point out, the application of transmission methods to traction work involves economic losses so considerable and serious that one will do well to stop and think twice before incurring them. In very many cases they can be more than offset by gains due to the very processes that involve them, but it is worth while to call forcible attention to the fact that such is by no means a foregone conclusion.

The Tool Works of Ludw. Loewe Co.

IN our present issue we continue the description of these works, which we commenced in our last number. As then stated, our object is to present some idea of the very high grade of organisation under which much of the work

is being done with which our manufacturers have to compete. More especially we would point out the general tidiness, which is in such marked contrast with the condition of our more old-fashioned works. Even in an old works we see no reason why each section of the shop should not be taken in hand in turn, stripped of all useless accumulation, cleaned and whitewashed, and its tools refired if necessary, and then put for the future upon the tool-room system, the starting of a tool-room being the first essential of good shop management. The tool room having been first organised, each section of the shop would be placed on the system as it was got ready, and soon the whole shop would thus be brought into line. We do not say that good work is not or cannot be done in the old-fashioned shops, but we do state emphatically that it cannot be done so cheaply as in a modern or well arranged shop, clean, and well provided with travellers. Moreover, the shops that are comfortable, and that provide for the comfort and cleanliness of the men, can have the pick of these, and with facilities for cleanliness, the presence of a dirty workman should be an offence against his fellows. At this present time manufacturing in German shops is comparatively modern. They are thus placed at a considerable advantage, just as so many of the new American shops have been. Our English shops are many of them old, and have grown up piecemeal, so that economy is hopeless, and reconstruction alone can save them. But there are newer shops that only want reorganising to come into the front line. The day has gone by when successful engineering construction can be carried out in abandoned cotton factories or other spent buildings. Light, air, warmth, cleanliness, and organisation, are all requisites to success. To obtain these in fullest measure has been the aim in the Berlin shops we describe, and no expense has been spared. At the same time there is no ornamentation and no striving after architectural effect; everything is subservient to its use. We note also that a department, as we may call it, of the business is that of furnishing the information that may be required by customers, regarding the provision of machines, gauges, and so on, for carrying on the production of a certain article in the best manner. In the modern system operations are very much divided. The absolute interchangeability of the parts of small things like rifles or sewing machines seems to be much easier to obtain than the same quality in large articles. Americans claim to secure it, but do not succeed to anything like the extent that is attained by, say, Willans & Robinson. In the ability to do things well our own people are not excelled; it is only in the conviction that the modern system is so necessary that some of them still appear wanting.

The Dangers of High Tension Supply.

It behoves station managers to take every possible precaution that experience and foresight can suggest to safeguard the lives and persons of those employed under them in construction and maintenance. We cannot, this week, go fully into one of the regrettable accidents which has just occupied the attention of a Coroner's jury, but may return to the subject again. The lessons to be learnt from the fatalities in electric light stations seem to be two-fold. Firstly, that unskilled workmen should never be permitted to do work in, on, or about high tension switch-gear or boards, unless a fully qualified and properly trained member of the technical staff be deputed to supervise the work, which should be carried on continuously under his eye. Secondly, that the Board of Trade and the Home Office will be forced to take stringent measures to ensure compliance with common-sense regulations, and if the "suggestions and recommendations" of the latter department be not acted on in the spirit, we shall certainly see rigid and hide-bound rules issued, as in other trades. Surely engineers are wide awake enough to recognise that, unless the documents issued by such authorities are read and adopted without compulsion, there will come a time when they will be coerced into taking care of the men they employ. Lastly, the Home Office should draft a sensible set of rules for safety, omitting mention of "india-rubber oil cans" and such like creations of the unpractical brain.

THE E.M.F. OF ALTERNATORS ON OPEN CIRCUIT.

By C. C. HAWKINS.

(*Continued from page* 656.)

Below are tabulated the values, with and without fringe, of the net average E.M.F., effective E.M.F., form factor, and K for one, two, three and four slots per pole, these slots

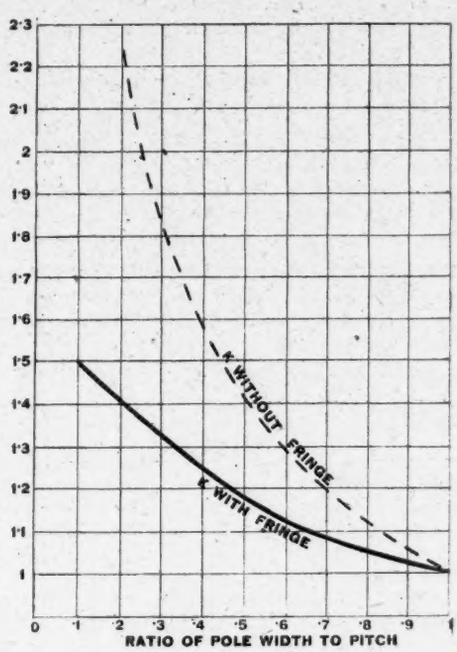


Fig. 3.—One Slot per Pole.

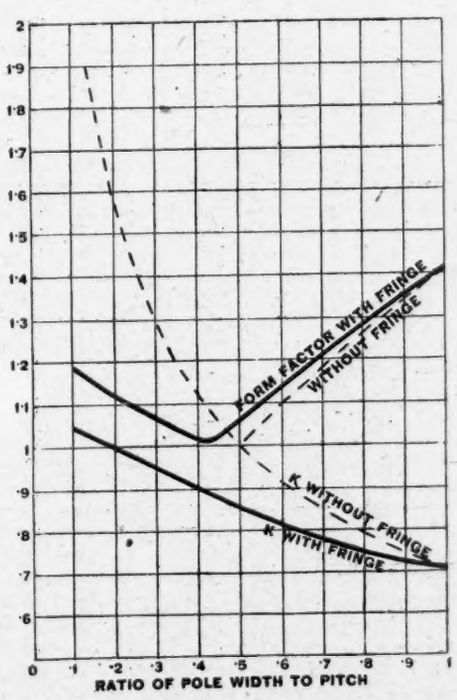


Fig. 4.—Two Slots per Pole.

being equally spaced over the pitch as might be the case in a single-phase alternator. The gross average E.M.F. for a pole-width equal to the pitch is represented in both cases by 1, 2, 3, 4, or more, according to the number of slots, and for other ratios of pole-width is equal to either the upper or lower line of fig. 2 multiplied by the number of slots. The

TABLE I.—NET AVERAGE E.M.F. WITHOUT FRINGE.

Number of Slots.	Ratio of pole width to pitch.									
	·1	·2	·3	·4	·5	·6	·7	·8	·9	1
One slot per pole	·1	·2	·3	·4	·5	·6	·7	·8	·9	1
Two slots ,, ...	·2	·4	·6	·8	1	1	1	1	1	1
Three ,, ,, ...	·3	·6	·9	1·066	1·166	1·266	1·366	1·466	1·566	1·666
Four ,, ,, ...	·4	·8	1·1	1·3	1·5	1·7	1·9	2	2	2
Fifty ,, ,, ...	4·75	9·0	12·75	16	18·75	21	22·75	24	24·75	25

TABLE II.—EFFECTIVE E.M.F. WITHOUT FRINGE.

One slot per pole	·316	·4475	·548	·632	·707	·775	·836	·895	·95	1
Two slots ,, ...	·4475	·632	·775	·895	1·00	1·095	1·182	1·265	1·34	1·414
Three ,, ,, ...	·548	·775	·95	1·152	1·352	1·53	1·66	1·75	1·832	1·913
Four ,, ,, ...	·632	·895	1·182	1·48	1·73	1·95	2·14	2·28	2·36	2·45
Fifty ,, ,, ...	4·84	9·32	13·45	17·15	20·4	23·21	25·6	27·3	28·42	29

TABLE III.—VALUES OF k' = THE FORM FACTOR WITHOUT FRINGE.

One slot per pole	3·16	2·24	1·825	1·58	1·414	1·29	1·195	1·12	1·055	1
Two slots ,, ...	2·24	1·58	1·29	1·12	1·00	1·095	1·185	1·265	1·34	1·414
Three ,, ,, ...	1·825	1·29	1·055	1·082	1·16	1·205	1·215	1·19	1·17	1·15
Four ,, ,, ...	1·58	1·12	1·075	1·14	1·15	1·145	1·125	1·14	1·18	1·225
Fifty ,, ,, ...	1·018	1·036	1·054	1·071	1·088	1·105	1·121	1·136	1·15	1·16

TABLE IV.—VALUES OF k WITHOUT FRINGE.*

One slot per pole	3·16	2·24	1·825	1·58	1·414	1·29	1·195	1·12	1·055	1
Two slots ,, ...	2·24	1·58	1·29	1·12	1·00	·912	·85	·79	·745	·707
Three ,, ,, ...	1·825	1·29	1·055	·96	·902	·8475	·79	·727	·68	·637
Four ,, ,, ...	1·58	1·12	·984	·927	·8625	·814	·765	·713	·657	·612
Fifty ,, ,, ...	·966	·932	·897	·857	·82	·78	·731	·682	·633	·58

* By some writers the coefficient 2 in the E.M.F. equation is combined with the following table, making each value of k twice that given in the present paper.

TABLE Ia.—NET AVERAGE E.M.F. WITH FRINGE.

One slot per pole	·264	·35	·436	·52	·6125	·7	·782	·86	·932	1
Two slots ,, ...	·4625	·625	·776	·92	·98	1·00	1·00	1·09	1·00	1
Three ,, ,, ...	·671	·8625	1·057	1·175	1·275	1·36	1·442	1·52	1·592	1·66
Four ,, ,, ...	·86	1·12	1·374	1·54	1·68	1·81	1·92	1·99	2·00	2·00
Fifty ,, ,, ...	10·05	13·12	16	18·3	20·7	22·4	23·5	24·45	24·8	25

TABLE IIa.—EFFECTIVE E.M.F. WITH FRINGE.

One slot per pole	·393	·494	·58	·65	·722	·79	·846	·904	·956	1
Two slots ,, ...	·551	·7	·83	·935	1·04	1·132	1·21	1·285	1·35	1·414
Three ,, ,, ...	·732	·921	1·11	1·3	1·48	1·63	1·74	1·82	1·88	1·913
Four ,, ,, ...	·912	1·18	1·45	1·68	1·9	2·06	2·20	2·3	2·4	2·45
Fifty ,, ,, ...	10·6	14	17·3	20	22·9	25·1	26·75	28·2	28·75	29

TABLE IIIa.—FORM FACTOR WITH FRINGE.

One slot per pole	1·49	1·41	1·33	1·25	1·18	1·125	1·08	1·05	1·025	1
Two slots ,, ...	1·19	1·12	1·07	1·015	1·06	1·132	1·21	1·285	1·35	1·414
Three ,, ,, ...	1·09	1·07	1·05	1·11	1·161	1·2	1·205	1·2	1·18	1·15
Four ,, ,, ...	1·06	1·052	1·065	1·09	1·13	1·136	1·145	1·155	1·2	1·225
Fifty ,, ,, ...	1·053	1·065	1·08	1·095	1·105	1·12	1·136	1·15	1·158	1·16

TABLE IVa.—VALUES OF k WITH FRINGE.

One slot per pole	1·49	1·41	1·33	1·25	1·18	1·125	1·08	1·05	1·025	1
Two slots ,, ...	1·045	1·00	·95	·9	·85	·81	·775	·746	·725	·707
Three ,, ,, ...	·925	·877	·85	·835	·806	·776	·742	·706	·672	·637
Four ,, ,, ...	·864	·845	·83	·808	·776	·735	·704	·67	·644	·612
Fifty ,, ,, ...	·805	·80	·795	·77	·748	·716	·685	·655	·617	·58

TABLE V.—RATIO OF MAXIMUM TO EFFECTIVE E.M.F. WITH FRINGE.

One slot per pole	2·54	2·02	1·72	1·54	1·385	1·265	1·18	1·11	1·045	1
Two slots ,, ...	1·81	1·47	1·3	1·285	1·54	1·765	1·65	1·555	1·48	1·414
Three ,, ,, ...	1·61	1·32	1·215	1·535	1·37	1·35	1·56	1·65	1·595	1·567
Four ,, ,, ...	1·405	1·25	1·42	1·35	1·368	1·475	1·49	1·65	1·666	1·63
Fifty ,, ,, ...	1·23	1·24	1·255	1·29	1·34	1·405	1·47	1·54	1·63	1·73

ratio of the net average E.M.F. to the gross average E.M.F. gives the width coefficient k'', and this multiplied by the form factor, k', gives the value of K. It is, however, needless to add a table of k'', since the product, K, may at once be obtained by dividing the effective E.M.F. by the gross average E.M.F. With a single slot there is no differential action, so that the net and gross E.M.F's. are identical, or the width coefficient is unity; consequently the value of K is the same as that of the form factor, and the curves of fig. 3 represent either the one or the other. In further explanation of the tables and corresponding diagrams, the reader may be reminded of certain facts bearing on the two cases.

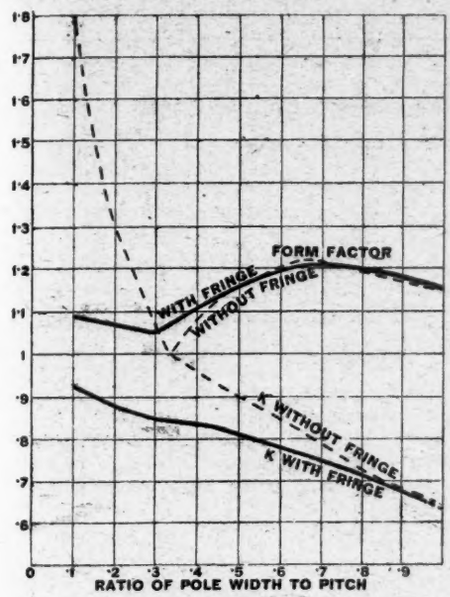


Fig. 5.—Three Slots per Pole.

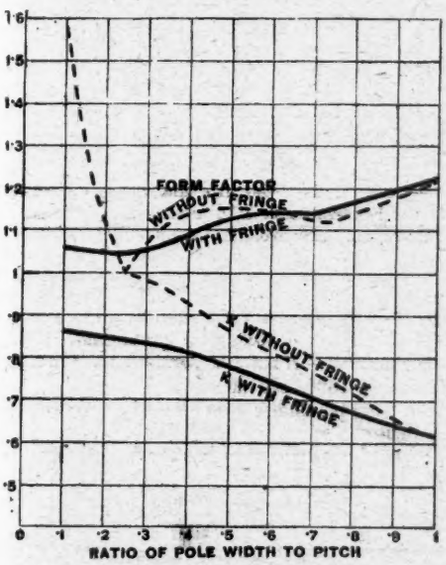


Fig. 6.—Four Slots per Pole.

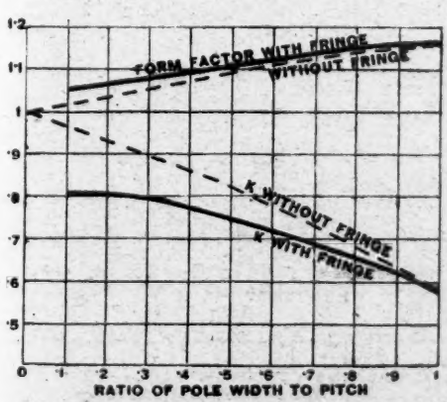


Fig. 7.—Uniform Distribution over Whole Surface.

When the fringe is neglected and the component curves are taken as rectangular, the form factor and K curves always pass through 1 when the pole-width ratio is equal to the space dividing two adjacent groups, *i.e.*, at ·5, ·333, and ·25 in the case of two, three, and four slots respectively. Differential action here ceases, and for lesser pole-widths the two curves coincide. The final rise of the curves then becomes more and more steep as the number of slots is increased; but when so large a number is taken that the winding practically covers the whole surface, the final K for zero pole-width assumes the value 1. In this theoretical

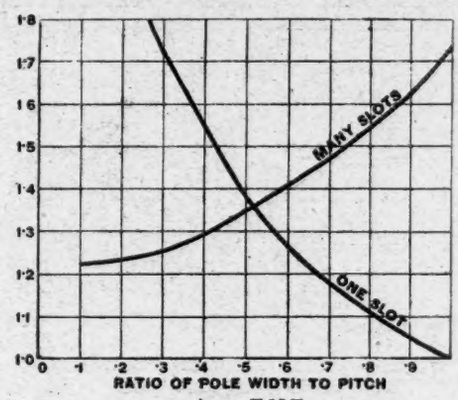


Fig. 8.—Ratio $\frac{\text{maximum E.M.F.}}{\text{effective E.M.F.}}$ with Fringe.

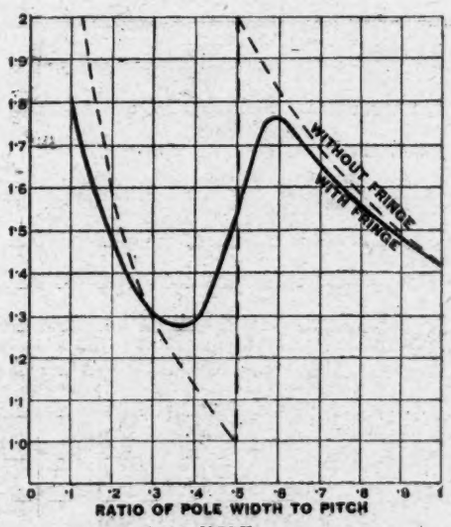


Fig. 9.—Ratio $\frac{\text{maximum E.M.F.}}{\text{effective E.M.F.}}$ for two Slots per Pole.

case where the normal induction is regarded as being maintained although the pole is reduced to a line, the

$$\text{ratio } \frac{\text{effective E.M.F.}}{\text{average E.M.F.}} \propto \frac{\sqrt{\text{infinitely small number} \times n}}{\text{infinitely small number} \times n}$$

where n is the number of slots, and this is always infinite, so long as n is finite, but becomes 1 when n is itself infinite. Next, the form factor curves for three and four slots have points of inflection, and corresponding inflections may be traced in the K curves. These are due to the altered state of affairs which is produced when the pole-width causes a new differential action to be set up; thus with three slots a maximum value of the form factor occurs at ·666, and with four slots a minimum occurs at ·75 and a maximum at ·5.

In the case of the two-slot curve, the change of curvature at ·5 is not so marked, but is present.

When the influence of the fringe is taken into account, and there is more than one slot, differential action is always present to a greater or less degree, and there are no abrupt changes at all. Consequently, although following in each case the same trend as when the fringe is neglected, the curves are on the whole more smoothed out. The points

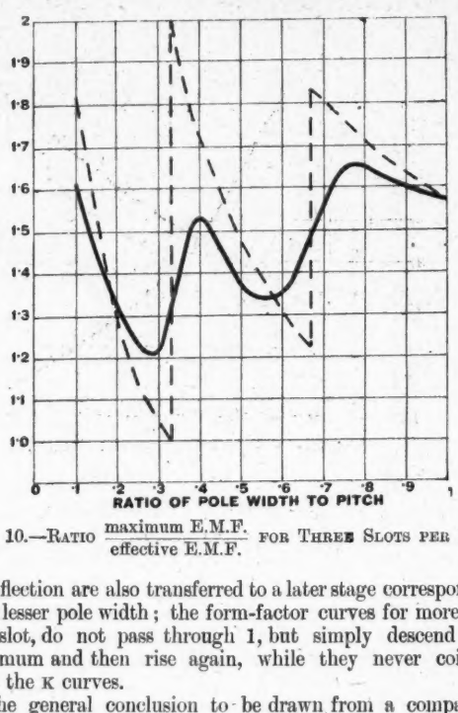


Fig. 10.—Ratio $\frac{\text{maximum E.M.F.}}{\text{effective E.M.F.}}$ for Three Slots per Pole.

of inflection are also transferred to a later stage corresponding to a lesser pole width; the form-factor curves for more than one slot, do not pass through 1, but simply descend to a minimum and then rise again, while they never coincide with the K curves.

The general conclusion to be drawn from a comparison of the curves with and without fringe is evident. When the fringe is taken into account the value of K is reduced appreciably. Further, the error involved in the assumption that there is no fringe is a maximum for a single slot, and gradually diminishes as the number of slots is increased; but even with a winding covering the entire surface of the armature is still considerable, unless the pole-width is unusually large.

Lastly, the ratio of the maximum to the effective E.M.F. is of interest to the designer, since from it must be deter-

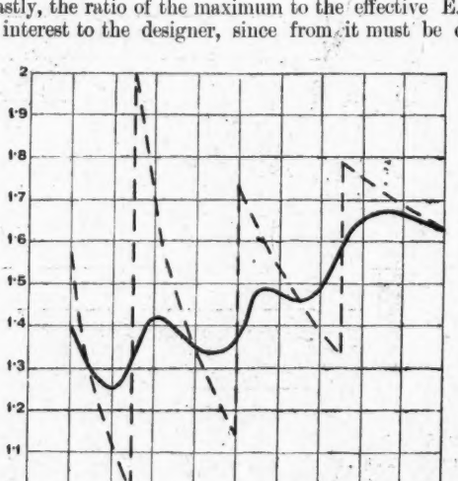


Fig. 11.—Ratio $\frac{\text{maximum E.M.F.}}{\text{effective E.M.F.}}$ for Four Slots per Pole.

mined the greatest voltage which the insulation has to withstand. Whilst the curves for one or a large number of slots are smooth whether the fringe be taken into account or not (fig. 8), the curves for two, three, or four slots are zigzags, having two or more maxima points according to the number of slots, which can be at one and the same time under one pole. When the fringe is taken into account, as shown by the full-line curve of figs. 9, 10 and 11, the zigzags are smoothed out into an undulatory curve of which the maxima values are reached with a greater pole-width than when there is no fringe, while the minima occur with smaller pole-widths. It will be seen that a great difference in the value of the ratio is produced by small differences in the pole-width, if this be such that it either just includes or excludes an additional slot.

(To be continued.)

THE CONTINUOUS CURRENT ARC.

In a paper read before the International Electrical Congress in Paris, Mrs. Ayrton made an important contribution to the practical side of the theory of the direct current arc, and also gave an interesting piece of reasoning on the nature of its physical constitution. The object of the paper was to discuss a curious relation between the total light emitted by arcs of different lengths, using the same current and the same carbons. This relation was shown by a set of curves plotted from the results of M. Blondel, and in fig. 1 we

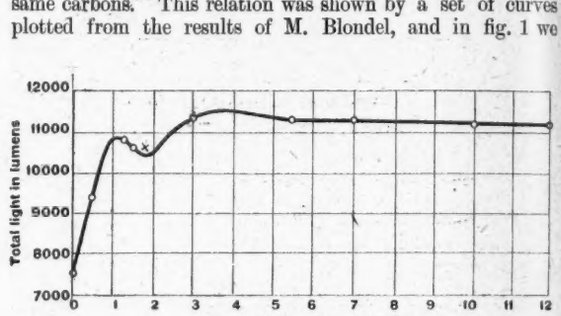


Fig. 1.—Curve Connecting the Arc Length with the Total Light Emitted from a 10-Ampere Arc. Carbons: Positive, 8 mm. cored; negative, 6 mm. solid.

reproduce the most characteristic of these. The occurrence of the curious dip at the point marked X in the figure indicates some hitherto unrecognised peculiarity. Prof. Ayrton had previously shown parts of similar curves in a paper read at Chicago in 1893, and the real existence of the maximum and minimum points has been verified by recent experiments at the Central Technical College.

The total light emitted by the arc depends mainly on two things, on the sizes of the crater and the white hot spot on

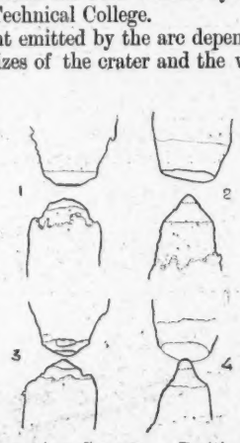


Fig. 2.—Forms of Arc Carbons. Positive, 13 mm. cored; negative, 11 mm. solid.

No. 1,	6 amperes	... ...	2 mm. long.
No. 2,	28 „	... ...	2 „
No. 3,	6 „	... ...	1 „
No. 4,	28 „	... ...	1 „

the negative carbon, and on their freedom of exposure, since the brilliancy of the crater is a constant quantity for given carbons, and the light given by the vapour of the arc, and of those parts of the carbons which are red hot is quite small. Now the size of the white hot spot has been found

by Mrs. Ayrton to be constant for a given current, and that of the crater nearly so, only increasing slightly with the length of the arc. Consequently, for an explanation of the dip at x in fig. 1, it is necessary to look to the form assumed by the carbons, and to the exposure of the crater and the white spot; and since the crater is by much the more important of the two, the form of the negative carbon which intercepts the crater light is much more important than that of the positive carbon which intercepts the light from the white spot. So far the matter is well understood, and the recognition of the value of small negative carbons is due to these considerations. Now Mrs. Ayrton showed in 1895 that with large currents and small arc lengths, the negative carbon assumes a much more taper form than when the currents are small and the arc length large, and that in the former case there grows a very sharp supplementary point at the extremity of the negative carbon, which disappears entirely when the arc is lengthened. The four figures of fig. 2 show this very clearly, and it is easy to see that the exposure of the crater is better in the short arcs than in the long ones. The meaning of the dip at x in fig. 1 is now clear. At a certain point the exposure of the crater is actually reduced by increasing the length of the arc, since the loss due to the change of the form of the negative carbon more than compensates for the gain due to the increased gap. The commercial significance of the observation is not in the absolute gain of light by the better exposure of the crater, but in the smaller power required to burn short arcs, so that if equal amounts of light can be obtained from long and short arcs, it is more economical to burn short ones than long ones. Mrs. Ayrton quotes her own expressions for the power absorbed in an arc, viz.:—

$$38{\cdot}88\ A + 3{\cdot}1\ l + 11{\cdot}66 \text{ watts at the carbon surfaces,}$$
$$(2{\cdot}07\ A + 7{\cdot}44)\ l \text{ watts in the arc,}$$

where A is the current in amperes, and l is the gap in millimetres.

In a 10-ampere arc, for example, for each additional millimetre of arc length 3 watts is converted at the light-giving surfaces, and 28 watts in the arc vapour, from which no useful light is derived. Thus the proportion of the whole power converted at the luminous surface is greatest in the shortest arcs. "Not only, therefore, does a short arc transform the greatest possible part of the power of the dynamo into light, but if it is also a large current arc, it permits us to utilise the greatest possible quantity of this light. In short, the very short arc with large currents combines all the conditions necessary for the greatest economy." To corroborate this result, Mrs. Ayrton plotted the figures of a number of M. Blondel's results in curves connecting the efficiency and arc length, and found her conclusions thoroughly supported.

There is one other consideration which tends to economy with short arcs; it is that the negative carbon, if not both carbons, is consumed more slowly than in a long arc for the same current. There are two reasons for this. First, the short arc extends further along the negative carbon, and protects it better from the air. Secondly, the carbon thrown off from the positive, instead of distributing itself and being dissipated, remains on the negative point and forms there, I think, that supplementary point which is the particular cause of economy in short arcs with large currents.

The sharpening of the negative carbons with large currents and a short arc has thus a very practical value. It allows us to approach the ideal conditions for the arc as regards economy. These ideal conditions are: (1) That the distance between the carbons be zero, and (2) that the extremity of the carbon be infinitely thin. It is true that this ideal can never be realised, but it is always well to recognise the ideal, for it points the way to progress. The most evident progress in this case would be: First, to employ with given carbons the shortest arcs and the largest currents possible, without approaching too near to the hissing point. Secondly, to find a negative carbon which, when burning in the arc, shall have an extremity even longer and thinner than the carbons employed at present, and which, nevertheless, shall burn much more slowly.

The second section of Mrs. Ayrton's paper deals with the nature of the arc itself, in proposing an explanation of the right hand part of the curve of fig. 1, where the emission of light decreases with the increase of the arc length. The conclusion is drawn that the arc contains particles of carbon condensed from the body of carbon vapour, which forms the general atmosphere of the arc. That the arc is in fact a carbon mist. The facts that are taken into account are the following:—

The light from the crater, believed to be constant intrinsic brilliancy, diminishes as the thickness of the arc atmosphere though which it is transmitted is increased, by increasing the arc length. The curve of fig. 1 falling steadily towards the right is evidence of this.

Herzfeld, in 1897, drew solid particles of carbon out of the arc by means of a highly charged plate placed 8 cm. from the arc.

One arc throws a shadow from the light of another arc. (A photograph to show this is reproduced in Mrs. Ayrton's paper, but no trace of the shadow can be seen.)

The light of the crater is similar in colour to that of the sun, whereas, from its temperature, it should be much yellower; unless the emissivity of the sun is supposed to be 10 times that of the crater, an unreasonable supposition. It is accordingly probable that some of the yellow light of the crater is absorbed in the arc.

The arc itself emits violet light.

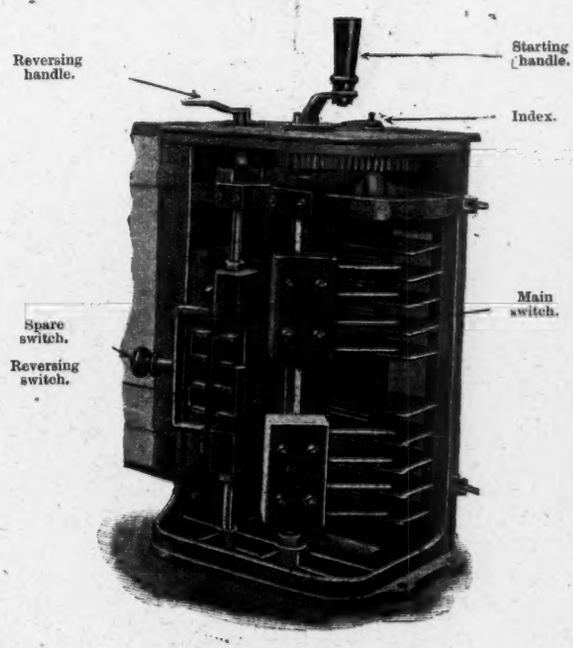
Mrs. Ayrton concludes that the arc consists largely of a carbon mist, the condensed particles of which absorb yellow light, and reflect violet light, and that the crater light transmitted through the mist loses intensity through absorption and repeated reflection.

THE BURGDORF-THUN POLYPHASE ELECTRIC RAILWAY.

Translated from the Danish paper *Ingeniören* by J. Lehmann and W. Park. The original article was written by Will. Rung, E.E., of the firm of Brown, Boveri & Co.

(*Continued from page* 616.)

The Contact Wires.—These consist of two 8-millimetre wires of hard drawn copper, supported by suspension wires, which are stretched between poles on either side of the track. The poles are wooden ones except those at the stations, which

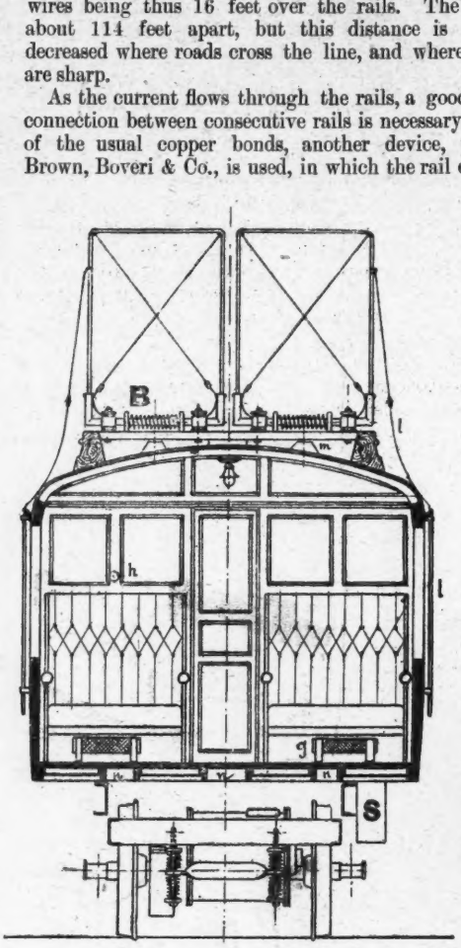


Controller.

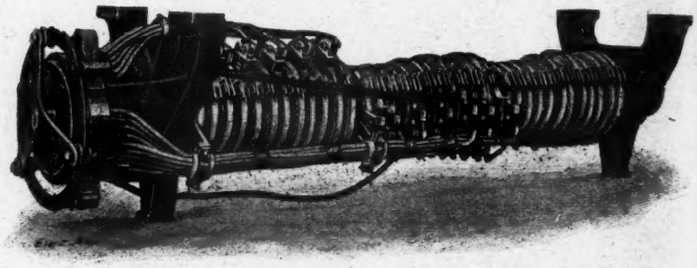
are made of iron. The insulation of the wires is double throughout, and each insulator has been tested for 6,000 volts pressure. The suspension wires consist of 6-millimetre steel wire, and are tightened by special straining screws, admitting of a lateral movement of 12 inches, so as to permit the contact wires to be placed exactly in their proper position above the rails. As a] [-shaped collector is used instead of the ordinary trolley, the contact wires are suspended in zig-zag fashion, so as to produce equal wear throughout the whole width of the collector. At their points of support, the wires

are placed 17 feet above the rails, the lowest part of the wires being thus 16 feet over the rails. The supports are about 114 feet apart, but this distance is considerably decreased where roads cross the line, and where the curves are sharp.

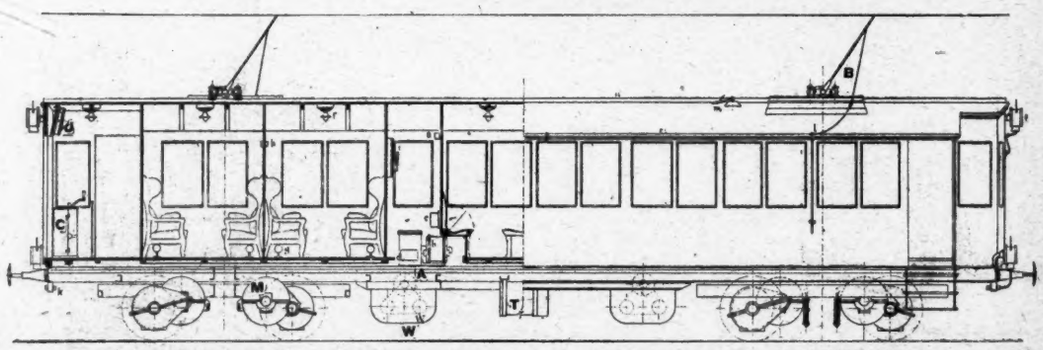
As the current flows through the rails, a good conducting connection between consecutive rails is necessary, and instead of the usual copper bonds, another device, patented by Brown, Boveri & Co., is used, in which the rail ends and the



Motor Car: Cross-Section.



Non-inductive Rheostat, without Cover.



Index to parts :—M, 60 H.P. 750-volt motor; W, Rheostat; A, Chain-gear for rheostat; C, Controller; B, Contact-bow; T, 18 KW. 750/100-volt transformer; S, Fuse-box; J, Volt and amperemeter; a, Lightning arrester; b, Air compressor; c, Automatic switch for compressor motor; e, signal-lamp; f, Glow lamps; g, Electric heater; h, Heater switches; i, Switchboard; k, Cable couplings for trailers; l, Device for hauling down the contact bows; m, Catch for contact-bows; n, Ducts for wires.

Motor Car: Part Sectional Elevation.

inner surface of the fishplates are scraped bright and covered with a metallic paste, which prevents the contact becoming oxidised, and the fishplates are afterwards firmly screwed against the rails. Comprehensive researches have fully proved this method to be absolutely reliable. Cross connections between the rails are provided at distances of 312 feet, and consist of copper wire 8-millimetres in diameter, screwed to the rails, and the connections treated with the same metallic paste.

Motor Cars. — Different rolling stock is used for passenger traffic and goods traffic, automobiles being used for the former, whereas the goods trains are drawn by electric locomotives. Each motor car or automobile can seat 66 passengers, and is able to run at a speed of 22 miles an hour when ascending a gradient of 1 in 40, and drawing a total weight of 26 tons (motor car and trailing cars). In special cases, two trains can be coupled together, the total capacity then being 280 passengers. The electric locomotives run at a speed of 11 miles an hour, and are able to haul 100 tons up an incline of 1 in 40. The gearing can be altered so as to produce a speed of 22 miles an hour, and the locomotives can thus be used when necessary for passenger traffic, in which case they are only able, of course, to draw half the above load. The automobiles have the same appearance as the common railway coaches. At each end of the car is an enclosed platform for the driver. The roof supports the ⌐⌐-shaped collectors, and under the framework are arranged the resistances and other parts of the electric equipment. Each of the four axles is driven by a 60-H.P. three-phase motor, which is partly carried by the axle itself and partly by spiral springs in the usual way. The gear consists of toothed wheels. The motors are wholly enclosed in cast-iron boxes, and have openings in the top fitted with loose covers, enabling the brushes and contact rings to be inspected from the interior of the car while running. Both of the motor bearings are self-lubricating. As far as the writer is aware, this type has never been used before in the case of railway motors, but it has proved a great success. The current collected from the overhead wire first passes the controller on the driver's platform, and from this goes through fuses to the stator windings of the motors. By withdrawing the corresponding fuses, any motor can be separately cut out of the circuit. The rotor current is led to a starting resistance, each motor having its own. To start the car the driver, by turning a handle through 90°, first switches on all four motors connected in parallel; he then cuts out by steps the resistance in the rotor circuit,* until it is finally short-circuited, so gradually increasing the speed until it reaches its maximum value. To stop the car he has to turn back the handle in the opposite direction. To reverse the motion and drive the car backwards, two of the stator leads are reversed by a switch in the controller. The starting handle and the reversing handle are mechanically connected together in such a way as to make it impossible to perform the various operations in the wrong order. Moreover, a reserve switch is provided in the controller, by which the current can instantly be stopped, independently of the other apparatus. The instruments for measuring the current and voltage, and a recording tachometer, are fixed to the wall above the controller. All passenger cars are fitted with Westinghouse brakes; for these an air compressor is mounted

* It would be possible to use a common resistance only if the two motors were mechanically connected so as to ensure their being always in phase, but this is, of course, not the case.

in each motor car, and driven by a 4-H.P. motor, which is supplied with current at 100 volts from a small transformer placed below the car frame The compressed air is stored in a cylinder under the car. The starting and stopping of the compressor motor is accomplished either by means of a common switch on the driver's platform or by an automatic switch worked by the compressed air. The brake-valve is placed immediately next the controller. The small transformer previously mentioned is also used for lighting and heating the compartments. The necessary fuses and other apparatus are installed on a special switchboard in a locked room on the car, where also the compressor and its motor are placed. In addition to the Westinghouse brake, each motor car is furnished with a common hand brake, acting on both sides of all eight wheels; these brakes, however, are never used except for stopping the train, no braking being needed when going down hill, as the motors automatically keep the speed constant, as already mentioned.

The arrangement of the entire installation will be understood from fig. 8. Some particulars of the automobile are added below :—

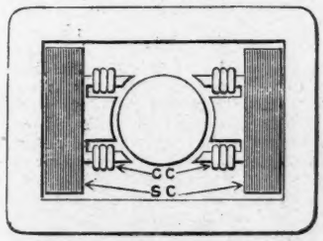
Total number of seats	= 66
" " second class... ...	= 16
" " third class	= 50
" " axles...	= 4
Distance between centres of axles in the trucks...	= 7 feet 2½ inches
Distance between centres of trucks ...	= 31 feet
" " buffers	= 53 feet 6 inches
Number of motors	= 4
Horse-power per motor	= 60 H.P.
Total horse-power	= 240 H.P.
Voltage	= 750 volts
Number of revolutions	= 600 per minute
Ratio of gearing	= 1 to 3
Speed per hour...	= 22 miles
Total weight	= 32 tons
Weight of car alone	= 22 tons
" " electric equipment ...	= 10 "
" " one motor	= 1·5 "

(*To be concluded.*)

CORRESPONDENCE.

New Constant Potential Continuous Current Transformer.

With reference to my article on "A New Constant Potential Continuous Current Transformer," published in your issue of the 19th ult., I would like to point out that, in the event of the machine therein described giving trouble by sparking at the brushes, that difficulty may be overcome by the following modification: Let the armature winding be the converse of that previously described, viz., let the *primary* armature coils be chord wound, and the



c c, Compensating coils; s c, Shunt coils.

Sketch of Transformer, Showing Arrangement of Compensating Coils.

secondary the full pitch; and let the compensating coils (four in number in this case) be wound on the polar horns, as shown in the annexed sketch. The compensating coils must be connected so as to assist the shunt winding.

The effect of increasing the load on the transformer will be to strengthen the magnetism of the horns, and, as this will affect only the E.M.F. in the secondary armature winding (owing to the small pitch of the primary coils), there will be a rise of the secondary voltage—the amount of which depends upon the pitch of the primary coils and the ampere turns in the compensating coils.

This arrangement will probably give better commutation owing to the magnetism of the polar horns being strengthened instead of weakened as the load increases.

Fred. W. Davies.

The Largest Motor-Generator Plant.

With reference to the letter of Messrs. Brown, Boveri and Co. in your issue of the 26th ult., relative to the above, we would like to point out that the paragraph referred to is perfectly correct if the words "installed by a single contractor" be added. The motor-generator sub-station in Milan referred to by Messrs. Brown, Boveri & Co., has been equipped by two contractors, namely, by the General Electric Company, U.S.A., and by Messrs. Brown, Boveri and Co. Moreover, the output of individual motor-generators is comparatively small.

The Manchester Square station of the Metropolitan Company will be equipped by us throughout with 500-KW. units, having a total capacity of close upon 3,250 KW. as stated; this is the largest motor-generator station equipped by one firm that we know of, and, as far as we know, the only one that can compare with it is Messrs. Kolben's station at Prague.

Witting Bros., Limited,
(Electricité et Hydraulique,)
A. C. Eborall, *Chief Engineer.*

LEGAL.

Recording Telegraphs, Limited.

Mr. Jenkins, Q.C., appeared before Mr. Justice Wright, in the Companies' Winding-Up Court, on Thursday last week in support of the petition of Segrue & Co., Limited, for the compulsory winding-up of the Recording Telegraphs, Limited. He said there was no opposition by the company, but since the petition had been put on the file a resolution had been passed for voluntarily winding-up.

Mr. Ashton Cross asked that the petition should stand over, as the company's assets consisted of shares in another company which held a valuable invention, which it was expected would become more valuable in a short time.

Counsel for other creditors supported the petition, which his Lordship ultimately allowed to stand over and be mentioned again.

The petition of Messrs. Segrue & Co., Limited, for the compulsory winding-up of the Recording Telegraphs, Limited, was again before Mr. Justice Wright, in the Companies' Winding-Up Court, last Friday.

Mr. Jenkins, Q.C., said the petition was by creditors, and Mr. Neville, who appeared for the petitioners on the previous day, said he was in a position to produce evidence to warrant a compulsory order. His (Mr. Jenkins's) clients did not want more than a supervision order.

Mr. Ashton Cross, who appeared for the company, said it was not in the interest of all the parties that a large number of valuable shares now in the hands of the company should be put on the market at present. They were, in fact, their principal assets.

Mr. Jenkins suggested that the best way would be to take an ordinary supervision order, as it would not interfere with the liquidator, who was the best person to realise.

Mr. Neville said he appeared for creditors for over £4,000, and he asked for a compulsory order.

Mr. Jenkins asked that the matter should stand over for a week.

Mr. Cross: No doubt some of these creditors are genuine, but others may be reduced in amount.

Mr. Jenkins said at present there was no evidence that a voluntary winding-up had been authorised. If a voluntary winding-up had been properly passed, he should like to amend the petition by stating facts which would justify a compulsory order or a supervision order, but he could not do that now. He formally applied for leave to amend his petition, in order to introduce such allegations as the evidence justified.

Mr. Cross said that the patents, which were practically all the assets of the company, were of great ultimate value.

Mr. Jenkins said there was nothing very large in connection with the company except its debts.

Mr. Cross: We wish to preserve these assets for the creditors.

His Lordship said the best course would be for Mr. Cross to file an affidavit showing there had been a resolution passed by the company for voluntary winding up; and the other counsel would then be at liberty to prepare evidence and adopt any course they thought fit. He adjourned the further hearing for a fortnight.

E

capacity then being 280 passengers. The electric locomotives always in phase, but this is, of course, not the case.

River Plate Electric Light and Traction Company, Limited.

In the Companies' Winding-up Court on Tuesday last week, before Mr. Justice Wright, the petition of Messrs. Glyn, Mills, Currie and Co. for the compulsory winding-up of the River Plate Electric Light and Traction Company, Limited, was down for hearing.

Mr. Eve, Q.C., for the petitioners, said that the petition had been standing over pending the receipt of a report from a gentleman who had been sent out to the Argentine Republic to investigate matters. He now asked that the petition should stand over until the first petition day of the next sittings.

Counsel for the company did not object, providing that certain information was given in the meantime, and the petition was adjourned as desired.

Coventry Gas Fittings, Electrical and Engineering Company, Limited.

Before Mr. Justice Wright, in the Companies' Winding-up Court, the petition of A. Davis and another for the compulsory winding up of the Coventry Gas Fittings, Electrical and Engineering Company was down for hearing. Counsel for the petitioning creditors stated that since the petition was presented a scheme of reconstruction had been laid before a meeting of the company, and a resolution was passed by the directors asking that the petition should be allowed to stand over for six weeks.

Mr. Buckmaster said he appeared for two creditors, who said they had no knowledge of the scheme, and wished it to be laid before them in a formal and proper way. He suggested a fortnight's adjournment.

His Lordship: Let it stand for six weeks, with liberty to apply earlier if necessary.

London Electrical Cab Company, Limited.

The petition of C. E. Foster and others for the compulsory winding up of the London Electrical Cab Company, Limited, was before Mr. Justice Wright in the Companies' Winding-up Court on Thursday last week.

Mr. Counsel, who appeared in support of the petition, read a lengthy affidavit, which stated that the company was formed in November, 1896, with a capital of £150,000, of which £100,000 was to be paid up. Its business was to acquire licenses from other companies for the sole use of electrically-propelled cabs in the metropolitan area. Only 63,614 shares were taken up on the strength of the prospectus, and allotted. Certain cabs were placed on the streets, but no dividend had yet been paid by the company. Afterwards the public was invited, in another prospectus, to subscribe the balance of the £150,000, but only about £12,900 was applied for and allotted. The petitioners complained that the directors were not justified in going to allotment on the shares applied for, and that the allotment was not made properly and in the interest of the company, and did not leave sufficient money for working expenses. It was also alleged that by the payment of £21,000 to the vendors, the directors had been guilty of misfeasance.

Mr. Stewart Smith, for the company, said the only effect of the petition would be to put an end to all the assets which the company possessed.

His Lordship said it was clear the company could not go on.

Mr. Smith said it was not carrying on business. The undertaking had been sold, in so far as it could be sold, and had realised £3,362 gross, which, of course, was divisible among the debenture holders of over £15,000, amongst whom were his friend's clients. The company's assets were two licenses from the British Motor Car Company and the Electrical Power Syndicate. These were exclusive licenses and had a surrender value. Some of the petitioners were shareholders and debenture-holders as well. As to the alleged misfeasance, he argued that the onus was on his friend to show specific acts. The winding up of the company, he argued, would put an end to the licenses, which were its only assets.

His Lordship asked what evidence there was of any value in these assets.

Mr. Smith said they were exclusive licenses for the use of certain patents in the metropolitan area.

Mr. Reed, Q.C., said he appeared, with Mr. Dunham, for two contributories whose conduct had been called in question, and they had filed affidavits dealing categorically with the charges made. He submitted that no useful purpose could be served by making an order to wind-up, because there could be no assets available for distribution amongst the shareholders. He argued that it was for the petitioners to show that some benefit would accrue to the general body of creditors on a winding-up order, which had not been done.

Mr. Bramwell Davies, Q.C., appeared for Mr. Evelyn Ellis, a director of the company, who, he said, held debentures to the extent of £7,000 and shares for £4,000 odd. He had put into the company £11,000 as compared with about £1,200 which represented the petitioners' interest. He contended that no possible good could accrue to the creditors from winding up unless misfeasance proceedings against the directors were successful. He submitted that his Lordship had no evidence of misfeasance before him, and that he should have something of a more tangible nature before him before he made an order. Mr. Ellis had filed an affidavit absolutely denying the statements made by the petitioners, and saying that he had acted *bonâ fide* throughout. The only thing was whether the directors were justified in paying over one-third of the amount subscribed to the vendors who sold them the licenses under which the cabs were made.

In reply to his Lordship counsel said the company had paid royalties of about £4 per annum on the cabs while they were in use. The whole of the plant had now been sold. He did not think the petitioners had shown any real substantial prospect of getting any assets by using the machinery of the Court and winding up the company, and urged that the allegations made against the directors were too vague for the Court to go upon.

Mr. Counsel, in replying, said there were many matters which required investigation, and there had been irregularities and concealments from the shareholders on the part of the directors which amounted to misfeasance. The whole of the cabs, for which the company paid some £60,000, had been broken up and sold for some £3,000, on the ground that the licenses could not be used. The licenses were therefore valueless.

His Lordship said he would read the affidavits and give his decision next week.

Judgment.

Mr. Justice Wright, in the Companies' Winding-Up Court on Wednesday, delivered judgment. Before his Lordship did so,

Mr. Steadman, one of the trustees, said he understood that it was stated at the last sitting of the Court that an order in the matter by Mr. Justice Byrne had been obtained by misrepresentations. If such a charge was made it would affect the trustees of the debenture holders. Both himself and the other trustee were substantial holders of deferred shares, and his partner's shares amounted to about £3,500. They felt that under the circumstances they could not take any part in connection with the realisation of the debentures.

His Lordship said he could not go into details, but it appeared to him that the trustees had taken all the needful steps. Proceeding to deliver judgment, he said the company was formed for the purpose of working street cabs by electric power some time ago. Now all this money seemed to have gone, and it was in a condition of being wound up. There were no unsecured creditors. The petitioners were secured shareholders and debenture holders, and they were entitled to an order if an order would do them any good. The only possible benefit he could suggest was that there might be results arising from certain proceedings. If there were any such results, they would, to the extent of £15,000, go to the debenture holders and not to the shareholders. If more than that was recovered it would go to the benefit of the shareholders. The petition was opposed by some large shareholders, some of whom were threatened with misfeasance proceedings on several grounds. The first was that there was no ground for believing that such proceedings would be successful, and that therefore a compulsory order would be useless. There were other reasons submitted against the order being made. It appeared that the company held patents, or exclusive licenses for patents, and that these might be of value. One of them was not assignable, and therefore could not be assigned to a new company. He saw no reason to doubt that the patents were of value, but no exact estimate was possible as to what that value would be—it must be a mere guess at present; it might be almost nothing, or it might be large. As to the objections, he did not think they were substantial enough to prevent his making an order. The petition, however, made a number of serious allegations, but it was supported by nothing in the way of evidence other than the statutory affidavit. A gentleman named Col. Foster had made an affidavit in support of the petition, but there was no reason to suppose that he knew anything whatever about the matter in the petition, except that his name was attached to it, and he (his Lordship) did not think he should act on the mere allegations of the petition without further evidence. He thought he should give an opportunity of producing further evidence if it would be of use to anybody. He had, however, the sworn evidence of the parties which dealt with the allegations made against them. He was clearly satisfied on the evidence before him that the main grounds on which the petition rested was a misconception founded on no basis of fact. There was an allegation of a payment of £50,000 to the licensors, one-third of which was to be in cash, but there was never any memorandum of agreement to that effect. There was another allegation that the directors had not enforced certain contracts, but he was satisfied that the directors thought that these contracts were not satisfactory, or that the articles supplied under them were not satisfactory, or that they could have done better elsewhere, so that there was no ground for proceeding against them on that score. It was also said that the directors put down a ridiculously low estimate for working capital, but he had no reason to doubt that the statements they made were made honestly, and that they did act in that and some other matters as alleged. As to the second prospectus, he did not think there was anything in it beyond undue confidence; and, in short, he did not think the suggested misfeasance proceedings would produce any result whatever. The petitioners might be quite right in saying that the company was crippled from the first by having to pay two-thirds in cash for the licenses to the vendors, but there were not sufficient grounds for making the order asked for. In the meantime nothing could be done for the benefit of the shareholders or debenture holders, and it would be wrong to terminate the existence of the company on the ground that it had ceased to carry on business. Making an order, too, was to destroy the value of one, at least, of the licenses. The best course, he thought, therefore, would be to let the petition stand over generally, and if the parties desired it, he might appoint an official independent liquidator to act, in conjunction with the receiver, in relation to the licenses and other matters, and whose sole function would be

to protect the interests of the licensees and shareholders. The receiver for the debenture holders was only concerned to get the debenture holders satisfied, and he would accept any sum that would satisfy them, and it might be that the real value of the licenses would be sufficiently large to leave a considerable sum over for the shareholders. As to the order made by Mr. Justice Byrne, that might probably be rescinded.

Mr. Counsel, for the petitioners, said he should like to have an opportunity of considering his Lordship's suggestion as to an additional liquidator.

His Lordship: Mention the matter to me next Wednesday.

Mr. Herbert Reed, Q.C., for the directors, said he had no objection to another liquidator, and he was ready on behalf of the gentlemen he represented to assist in every possible way.

Mr. Counsel said all personal charges against the directors had been withdrawn. He asked his Lordship to make no order as to costs. The statements made against them, he should be able to show, were based on the best evidence before the petitioners.

His Lordship said the alleged secret agreements had not been supported by evidence, and therefore there must be an order as to costs, either now or at a later date. The matter could be settled before the taxing master. It could be mentioned again on Wednesday next.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Oct. 31st, 1899.

Adelaide		Value £268
Alexandria		90
"	Teleph. mat.	54
Bangkok		49
Boca		1,168
"	Teleg. mat.	409
Bombay		147
"	Teleg. wire	59
Brisbane		16
Buenos Ayres		750
"	Teleg. wire	479
Calcutta		276
Cape Town		410
Christiania.	Teleg. wire	86
Colombo		1,029
Copenhagen		263
Durban		16
"	Teleg. wire mat.	4,168
East London		558
Gothenburg		30
"	Teleg. wire	15
Hong Kong		15
Madras		16
Monte Video.	Teleg. mat.	72
North Sea.	Teleg. cable	2,200
Port Elizabeth		151
Port Said		89
Santos		38
"	Teleg. mat.	174
Sydney		251
Valparaiso		112
Venice.	Elec. launch machy.	500
Vera Cruz		30
Wellington		370
Yokohama		140
"	Teleg. cable	566
	Total	£15,161

Week ending Oct. 30th, 1900.

Adelaide		Value £2,087
Amsterdam		85
Bombay		75
Buenos Ayres.	Teleg. mat.	150
Calcutta		1,208
Cape Town		472
Christiania.	Teleg. wire	44
Colombo		446
Copenhagen		15
"	Teleg. wire	17
Durban		279
"	Teleg. mat.	87
Gothenburg.	Teleg. wire	16
Hamburg.	Teleg. mat.	550
Melbourne		1,005
"	Teleg. wire	1,016
Ostend		208
Perth		200
Piræus.	Teleg. apparatus	100
Rio Janeiro.		176
"	Teleg. mat.	185
St. Petersburg		10
Santiago		25
Shanghai		215
"	Teleg. cables, &c.	2,090
Singapore		287
"	Teleg. cable	147
Stockholm.	Teleg. mat.	65
Sydney		2,088
"	Teleg. & teleph. goods, &c.	5,100
Tokio		505
Yokohama		769
"	Teleg. cable	3,793
	Total	£23,600

Foreign Goods Transhipped.

Hong Kong.	Elec. plant	Value £50
Melbourne.	Elec. motors	100
	Total	£150

Perth.	Elec. goods	Value £1,011
Stockholm.	Elec. goods	35
	Total	£1,046

Auction Sale.—Messrs. Percy Huddleston & Co. will sell by auction on November 15th the stock of an electrical apparatus manufacturer at Manchester (*in re* Donnison, Barber & Co.). See our advertisement pages this week.

Bankruptcy Proceedings.—On Friday last, at the Burnley Bankruptcy Court, before Mr. Registrar Hartley, Robert Foster & Walter Baker, electrical engineers, Nelson and Burnley, appeared for their adjourned examination. The Official Receiver applied for a trading account from January, 1899, a bought and sold account, and a further deficiency account to be made out. The Registrar made the necessary order, and the examination was adjourned.

Dissolution.—Messrs. F. C. Smith and J. W. Roberts (Smith, Roberts & Co., electrical engineers, Chapel Street, Southport), have dissolved partnership. Mr. Smith will carry on the business as the Southport Electric Light Company, and he will attend to debts, &c.

Books Received.—"Proceedings of the Municipal Electrical Association" for 1899 and 1900. Huddersfield: A. B. Mountain, Corporation Electric Supply Station, St. Andrew's Road. 3s. 6d. each.

"Theory and Calculation of Alternating Current Phenomena." By Charles P. Steinmetz, with the assistance of E. J. Berg. New York: *Electrical World and Engineer.*

"The Practical Engineer Pocket Book, 1901." Technical Publishing Company, Limited. 1s. and 1s. 6d.

Coal Conveying Plant.—We learn that Messrs. Graham, Morton & Co., Leeds, have obtained a contract from the Edinburgh and Leith Corporation's Gas Commissioners, amounting to the sum of £113,802, for the erection of a complete automatic inclined retort carbonising plant, including their improved system of elevating and conveying machinery for handling coal.

Edinburgh Cable Trams.—The *Tramway and Railway World* has issued a reprint of its articles describing the cable tramways of Edinburgh. Messrs. Dick, Kerr & Co. were the principal contractors for this system.

Electrical Enterprise in Staffordshire.—From a local correspondent we understand that a well-known London firm of electrical engineers has acquired a site of about 50 or 60 acres at Stafford for the erection of large electrical construction works. The name of the firm has not yet been officially disclosed, but we understand that the negotiators are Messrs. Siemens Bros., whose representative had previously visited Wolverhampton, where the electrical industry is a staple trade, but failed to obtain a suitable site. It is estimated that some 700 or 800 people will be employed at the new works at Stafford, the site for which is adjacent to the London and North-Western main line. Electric works of some importance are being erected at Ocker Hill, in Staffordshire, by the Midland Corporation for the Distribution of Power. These works, which are the first of their kind established under an Act of Parliament, and not under a temporary provisional order, will, it is said, comprise the largest electric power installation in England. They will supply electricity to the Mines Drainage Commissioners for the pumping of water out of the coal mines in the Black Country, and there should also be a good demand from manufacturers, for the Midland Corporation will be able to sell electricity at a much cheaper rate than an ordinary manufacturer could produce it at for his own needs. In the neighbouring county of Warwickshire, the Thomson-Houston Company are building works at Rugby.

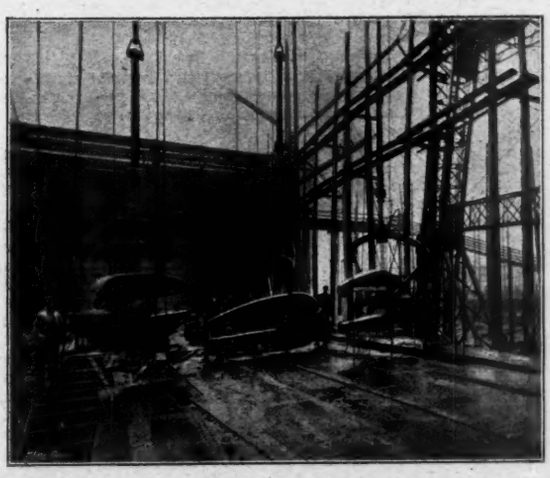
Electricity in Printing.—Messrs. Geipel & Lange, who are the sole agents for the United Kingdom for the "Ward-Leonard" system of operating electric motors for the driving of printing machinery of all kinds, are applying a 50-H.P. motor, constructed on this system, to a printing machine in one of the largest newspaper offices in London.

Fire.—A fire broke out on Monday night at the Premier Electric Lamp Works, Huyton Quarry, near Liverpool. The flames were confined to the finishing shop, and were extinguished before serious damage was done.

For Sale.—The West Ham Council is offering for sale two 24-B.H.P. Crossley gas engines. See advertisement pages to-day.

Gloucestershire.—Messrs. Tubbs, Lewis & Co., of Kingswood, Gloucestershire, elastic, cord, braid and pin manufacturers, have rebuilt their Abbey Mills which were destroyed by fire in 1899. The new premises have been installed and fitted with electric light plant supplied by Messrs. Christy Bros. & Middleton, of Chelmsford.

Hydraulic Machinery.—In these days of high wages and low prices, labour-saving machinery is always an interesting subject, so no excuse is needed for drawing attention to the



Hydraulic Riveters.

hydraulic riveters which we illustrate herewith. These are suspended by cranes from a hydraulic gantry, which was first used by Messrs. Harland & Wolff in the building of the *Oceanic*; by reason of the ease with which they may be moved in either a vertical or

denying the statements made by the petitioners, and saying that he had acted *bonâ fide* throughout. The only thing was whether the

dent liquidator to act, in conjunction with the Receiver, in relation to the licenses and other matters, and whose sole function would be

a horizontal plane, so as to bring them to any point desired, it was possible to do almost the whole of the rivetting by their means, and the satisfaction they afforded may be gauged by the fact that two similar gantries were immediately ordered by those well-known shipbuilders from the makers, Messrs. Fielding & Platt, Limited, of Gloucester.

The latter firm is now engaged in completing four of the largest hydraulic coal tips ever installed, for the Taff Vale Railway at Penarth. The capacity of each of these is 60 tons per hour, a truck being lifted a height of 45 feet, tipped, and returned, in 60 seconds—a higher speed than has ever been previously attained.

Messrs. Fielding & Platt's engineering works, which we had the pleasure of visiting on Election Day, were founded as long ago as 1866, and since 1875 have turned out large numbers of hydraulic machine tools on the Tweedles system, of which the hydraulic rivetter was among the first introduced; the firm now employs between 600 and 700 men in the manufacture of hydraulic machine tools of all kinds, as well as of pneumatic rivetters, &c. An important department of the works is devoted to the manufacture of the "Fielding" gas and oil engines; the former, which follow the Otto cycle, are made of all powers up to 130 B.H.P. (single-cylinder), and the latter up to 40 B.H.P. It is interesting to add that the motive power for the works is provided by engines working with producer gas, all made on the premises. The steam plant formerly in use, of 130 I.H.P., used 45 tons of coal per week, about 11 tons of which was required for steam hammers; the present gas engine plant, of 130 B.H.P., takes 8 tons of anthracite per week, together with the 11 tons of steam coal above mentioned, and allowing for the higher price of anthracite, effects a total saving equivalent to 18 tons of steam coal per week of 108 hours. Messrs. Fielding & Platt attribute the very satisfactory results attained to the fact that they are the makers of both the engine and the gas generator. We may add that this firm supplied the plant put down at King's Lynn Electric Lighting Works, as well as many large private installations.

Hydraulic Gantry.

London County Council.—It was decided at a meeting of the Council on Tuesday to advance a loan of £21,000 to the Bermondsey Vestry for the erection of a refuse destructor and the laying of electric lighting mains, and £25,000 to the Poplar District Board for the purposes of the electric lighting installation.

Electric Tramways.—The adjourned report of the Highways Committee was brought forward in relation to the contemplated tramway from York Road, Wandsworth, to High Street, Tooting. In connection with this matter, it appeared that the Wimbledon Urban District Council proposed to seek powers for the construction of a system of electric tramways from the Wimbledon railway station *viâ* Merton Road and High Street to the county boundary at Waterfall Bridge, and had asked that the County Council should promote a line from the present tramway terminus at High Street, Tooting, to Waterfall Bridge, so as to connect with the proposed tramways of the District Council. The Committee, who were in favour of the proposal, recommended the Council to apply in the next session for powers to construct the suggested tramway, and this was agreed to.

The adjourned report of the Parliamentary Committee reminded the Council of the withdrawal last session of the proposal to reconstruct, as a double line for electric traction, the existing single line from Camberwell Green to Vauxhall, and for the widening of Camberwell New Road and Harleyford Street for the purpose of such reconstruction. As the Highways and Improvements Committees desired that those proposals should be renewed in the next session, the Committee recommended, and the Council decided, to adopt that course.

The Metropolitan Electric Supply Company.—The report of the Highways Committee mentioned that the Metropolitan Electric Supply Company had served an unsigned and imperfect notice dated October 10th, with nine maps, of intention to lay mains in 406 streets within the areas scheduled under its Paddington, West London, and Mid-London orders, and that on attention being drawn to the irregularity, the company had served an amended notice and the same maps. The Committee stated that the amended notice was obviously incorrect, as it referred to the laying of mains in several streets, the sites of which had been appropriated for the Great Central Railway; but irrespective of that, the company expressed inability to give any date for the commencement or completion of any particular part of the work, and presumed that the Council would sanction the whole, and would require that for any works not completed within one year, a further sanction should be obtained from the Council before the works were proceeded with by the company. It appeared evident to the Committee from the amount of work shown on the maps that the company had no intention of completing the whole of the works within 12 months. If all the works were approved by the Council at one time, they could not be kept properly under observation while in course of execution; and in the circumstances the Committee thought that the Council should formally disapprove the works proposed in the notices and maps. If the Council adopted that course the Committee intended to suggest to the company to submit a fresh notice and plans with regard to works which it might propose to execute immediately or within a reasonable period. The Committee recommended the Council to disapprove the works referred to, and the proposal was adopted.

Paris Exhibition.—We understand that the two 60-H.P. motors which Messrs. J. P. Hall & Co. exhibit at the Paris Exhibition driving the cotton-spinning machinery on Messrs. Platt Bros. and Co.'s stand, have been awarded the silver medal. These motors are fully described in a pamphlet we have received from Messrs. Hall, and also in their new catalogue which was sent out recently.

Refuse Destructors.—The Horsfall Furnace Syndicate is to supply five additional refuse destructors to the Bradford Corporation.

Street Lighting.—The problem of economically illuminating streets which are not of sufficient importance to justify the installation of arc lamps, is one which is ever present to the enterprising central station engineer. It must be admitted, however, that while the arc is unrivalled, the success attained in convincing local authorities that glow lamps are better and cheaper than gas lamps for this purpose has not always been of the most gratifying character. A determined attempt to improve the standing of glow lamps in this direction is being made by the Improved Electric Glow Lamp Company, Limited, who are introducing 2 and 3-light fittings adapted for use with their reflector glow lamps, familiar to our readers, and suitable for the conversion of existing gas lanterns. Owing to the silver reflectors, it is claimed that the light is concentrated in those directions in which it does the most good, and that an effective illumination is secured nearly double that obtained with other systems for the same power. To attain this end the lamps are mounted back to back, with their axes at an angle of 20° with the horizon, so as to project the beam in the desired direction. In a catalogue which we have received these fittings are illustrated, as well as watertight switches and fuses, bracket arm attachments, &c., and a number of diagrams illustrating the efficiency of the illumination as compared with other systems are included.

Trade Announcements.—Messrs. Wheatley Kirk, Price and Co. announce that, to meet the increasing demands of their business, they have taken larger premises at 46, Watling Street, Queen Victoria Street, E.C.

Messrs. R. J. Brocklebank & Co., electrical and general engineers, have removed from Lorne Road to more commodious premises at Pocklington's Walk, Leicester.

Wind Power.—The *Newcastle Chronicle* says that the electrical utilisation of wind power is being tried in the Baltic region. An experimental plant, consisting of a windmill, a dynamo, a battery of accumulators, and electric motors, has been put up at Wittkiel, near Kappeln, situated at the entrance of the Schlei, the longest of the narrow fjords which the Baltic sends into Schleswig. The wind motor has been constructed by C. P. Neumann, of Wittkiel.

ELECTRIC LIGHT AND POWER NOTES.

Agriculture.—According to *Commercial Intelligence*, Mr. Consul Hughes, of Coburg, reports:—"In this and neighbouring parts of Germany considerable attention is being paid to electrical appliances for farm use. Near Ochsenfurt, in Bavaria, a company

By Charles P. Steinmetz, with the assistance of E. J. Berg. New York: *Electrical World and Engineer.*

Messrs. Harland & Wolff in the building of the *Oceanic*; by reason of the ease with which they may be moved in either a vertical or

composed of landowners and small farmers has been organised for the establishment of an electrical system for use on their farms and in villages. The power is to be generated by steam and water, and the current to be distributed from a central station to the places at which it is wanted." British farmers please copy.

Atherton.—Notice of the U.D.C's. application for a provisional order appears in the *London Gazette.*

Barry.—The T.C. has resolved to apply for a prov. order for electricity supply.

Bath.—At a meeting of the E.L. Committee last week, it was reported that during the quarter ended September 30th, 1,652 C.P. lamps had been installed by 29 new consumers. When the installations were completed there would be a total of 26,630 8-C.P. lamps connected to the supply mains.

Birkenhead.—A special report of the position of the Birkenhead Corporation electric lighting department was submitted by the Electrical Committee to the Town Council on Friday last. The report shows that the gross surplus of the undertaking, based on the present charges for the year ending March 31st next, will be about £375. If the price had been 4d. per unit, there would have been a deficit of £949 5s. The consumption of electrical energy in the borough for the year ending March next is estimated at 315,232 units. The Sub-Committee consider that the charge for electrical energy cannot, therefore, be reduced to 4d. without incurring a loss. They are, however, prepared to revise the charges. Under a proposed new scale, consumers who use their maximum for one hour and under, daily, will pay 6d. per unit; for two hours daily, 4½d. per unit; for three hours daily, 3½d. per unit; for four hours daily, 3d. per unit. For power and heating, the Sub-Committee recommend that the present charge of 6d. per unit be reduced to 4d. for the first hour's maximum demand, 3d. for the second hour, and 1½d. per unit after. These reductions, coming into operation on December 31st next, would reduce the amount of surplus for the year ending March next to £200.

A recommendation of the Gas, Water and Electrical Committee, that after the present municipal year the Committee should be relieved of the management of the electric lighting undertaking of the Corporation, and that the Council should instruct the Selection Committee to recommend the Council as to the future management of the undertaking, was approved of.

Blairgowrie.—A special meeting of the Police Commission was held last week to consider the intimation of the North British Electric Supply Company that they were going to apply for a prov. order to supply electricity within the burgh. The Commissioners thought of applying for an order themselves, with a view of transferring the same, under a suitable arrangement, to a company to work it, but, finding that the Board did not allow power to transfer, they resolved not to apply for an order, and to take no further action in the matter.

Boston.—The T.C. has decided to engage an expert to make a report with regard to the lighting of the town by electricity.

Bournemouth.—The directors of the Bournemouth and Poole Electricity Supply Company have arranged for a conference between a deputation from the T.C. and representatives of the company, to discuss the proposed purchase of the company's undertaking by the Corporation.

Bray.—Out of a list of 46 candidates for the post of electrical engineer, the U.D.C. has selected the following gentlemen for interview:—Messrs. H. T. Lee, Wakefield; H. G. Nicholson, Southampton; J. Moss, Eccles; T. Tomlinson, Liverpool; H. B. Price, Great Eastern Railway; and S. W. Martin, Rathmines. We learn that Mr. Tomlinson has been appointed.

Cardiff.—There is still some friction among the staff of the electricity works. At a meeting of the Electrical and Lighting Committee last week, the chief business was a report by Mr. Appelbee, chief engineer, and some letters from Mr. Illingworth, mains superintendent. At the outset one of the members resigned his seat on the committee. During the discussion, Mr. Illingworth was sent for, when it was ascertained that although he had received notice of the meeting, he had decided to absent himself. Eventually the committee resolved to ask Mr. Illingworth to resign his position.

Cork.—"C. E.," writing to the *Dublin Daily Express* with reference to the Electric Committee's decision to accept a tender for lead-armoured cables for the high and low tension mains, says in a footnote that he hears "that the Cork system, which was laid down only two years ago with armoured cable, is being entirely reconstructed, all armour being abandoned."

Criccieth.—The D.C. has had under consideration the matter of lighting the town with electricity, as proposed by the Manchester Company, promoted by Messrs. Bennett and Ward-Thomas, which proposes to light up Pwllheli and Portmadoc. The Council was unanimously in favour of the scheme, subject to an understanding with the company.

Crompton.—The D.C. of Crompton, one of the outlying districts of Oldham, decided last week to obtain prov. orders for the supply of electricity and the construction and working of tramways within the district.

Dewsbury.—On Tuesday an inquiry was held into an application of the T.C. for sanction to borrow £7,500 for the purpose of extending the electricity works and mains. The works were started in 1894, and the demand for the light has increased from year to year. In 1898 there were 101 consumers, whose connections were equivalent to 8,056 8-C.P. lamps. Now there are 194 consumers, and the connections are equivalent to 14,683 8-C.P. lamps. Last year a profit of £201 was made, but in previous years there was a loss, which had to be made good out of the rates. The Corporation now proposes to extend the mains into new districts. The new machinery which is being put in is also designed with the object of supplying energy to the British Electric Traction Company, who propose to run trams in the district. There has recently been a great increase in the demand for energy for motive power. There was no opposition to the application.

Dorking.—The D.C. has received notice from the County of Surrey Electrical Power Distribution Company, Limited, to the effect that the company intends to apply for powers to supply electricity in the district. The matter has been referred to a committee.

Dover.—The Admiralty Pier, Dover, is being lighted electrically throughout; the work is being carried out by Messrs. Dennison, Berlyn, Sillem & Co.

East Molesey.—Mr. H. J. Robertson, J.P., chairman of the East and West Molesey Urban District Council, has expressed his determination to resign office on account of irreconcilable differences with his colleagues on a question of lighting the district with electricity. Mr. Robertson was anxious that the offer of a private company should be accepted in the matter.

Eastbourne.—The T.C. has resolved that application be made to the L.G.B. for power to borrow the sum of £31,912 for the erection of a new electric light station at Roselands, new transformers, mains, &c., as set forth in Mr. Hawtayne's report.

Eccles.—Since the incorporation of the town there has been an enormous increase in the population. Upon a report of the electrical engineer, the Works Sub-committee have recommended the Council to purchase a feeder cable and the necessary drawing-in boxes. Further, they suggest that the tender of the British Insulated Wire Company, Limited, for the same be accepted at a total cost of £515.

Friern Barnet.—The D.C. has resolved to apply for a prov. order for lighting the district with electricity.

Gainsborough.—The U.D.C. has given notice of its intention to apply to the B. of T. for a prov. order to supply electricity within the urban district.

Gloucester.—At a meeting of the City Council last Tuesday Mr. Hammond reported that the electrical plant had been running satisfactorily since July 19th, and that a complete series of tests lasting over five days had been successfully carried out recently. In formally handing over the installation to the Council's engineer, Mr. Hammond congratulated the Council on the fact that the full output of the works was already taken up, to the extent that part of the public lighting had to rest in abeyance for the present. Fortunately, the extension plant already on order will double the available output. The total expenditure to date stands at £51,025. Further outlay will be necessitated by the extension of the public lighting and the proposed supply to the tramway company.

The T.C. has appointed Mr. W. J. Bache as resident engineer, at a salary of £250 a year.

Handsworth.—In respect to an application by the Northern Counties Electric Supply Company for leave to obtain powers for the lighting of Woodhouse, the D.C. instructed the clerk to inform the company that the whole of the parish of Handsworth must be included, and empowered him to conclude the necessary arrangements with the company.

Honley.—The D.C. has resolved to apply to the B. of T. for a prov. electric lighting order.

Inverness.—According to the *Edinburgh Evening Dispatch*, the Inverness T.C. is unable to agree with the late electrical engineer, Mr. Craven, as to the amount due to him on account of the abandoned electric lighting scheme. The T.C. offers 2½ per cent. on the estimated cost of the scheme, plus £59 expenses, while Mr. Craven claims 3 per cent. and £140, making a total of £950.

Kingston-on-Thames.—At the meeting of the T.C. on Friday last, Mr. Collings, chairman of the Lighting Committee, dealt with some hostile criticism directed against the Corporation's electrical department by Mr. G. Bolton, J.P., to which we referred recently. Mr. Collings pointed out that the reason why two sets of accounts were printed was because the B. of T. insisted on having accounts and balance-sheets made up to December 31st, whereas the Corporation accounts were dated to March 31st, and, moreover, were cash accounts, and did not show assets and liabilities. With regard to the alleged loss on working, he said that there was a difference between the position of the Corporation, who were repaying the money borrowed year by year, and that of a company, whose capital was not thus paid off.

mittee intended to suggest to the company to submit a fresh notice

parts of Germany considerable attention is being paid to electrical appliances for farm use. Near Ochsenfurt, in Bavaria, a company

Leigh.—The T.C. is about to spend an additional £5,000 on the electricity undertaking, in consequence of the increasing demand.

London, E.C.—The *Times* gives a summary of the annual report of Mr. A. A. Voysey, electrical engineer and inspector to the Corporation. Mr. Voysey states that last year the total number of arc lamps in lighting was 507. During the year 562 lamp failures were reported by the police, and 356 by the inspector. The penalties inflicted on the company for failures amounted to £173 6s. 3d. The Corporation was still without the means of testing the value of the supply given to the public lamps. The Board of Trade had not formally approved of any type of instrument for the purpose, but one of the conditions on which the City of London Electric Lighting Company were allowed to change the standard pressure from 100 to 200 volts, was that they established, concurrently with the change, and under the direction of the Board, a means of testing the value of the supply to the public lamps. Only 11 meters were submitted to the inspector last year. Nine were sufficiently correct, but the others were incorrect. The Aron meter was approved by the Board of Trade for use on alternating current circuits, and the inspector made a number of tests with a view to determine the kind of examination that would be necessary before certifying such meters in accordance with the provisions of the electric lighting orders. Negotiations had been concluded between the Corporation and the companies for the testing of all meters at Guildhall without expense to the Corporation. The companies had agreed to refund to the Corporation the whole of the money expended in carrying out the work, including the salary of the inspector. The question of the lighting of the side streets had been delayed for several years in the endeavour to obtain a legal settlement of differences with the City of London Electric Lighting Company as to the meaning of the public lighting agreements. The inspector was advised, during 1899, of two important interruptions in the supply of electricity to private consumers—one affecting the whole of the City, and the second affecting only a portion of the City. Defects in the pressure of the supply occurred on 11 different occasions. At present the inspector had no adequate means of ascertaining how far the company complied with their obligations in respect of the maintenance of a proper pressure of supply to private consumers. The company, however, had been put under the obligation to provide such means as the Board of Trade should direct.

St. Pancras.—At a meeting last week the Vestry accepted applications for current from consumers who will require an estimated supply of 822 amperes. The chairman of the Electricity Committee (Dr. Smith) presented an interesting report of a visit he made, accompanied by Mr. G. A. Hodgkinson, the deputy chairman of the Committee, and Mr. S. Baynes, the chief electrical engineer, to the Paris Exhibition. He stated that there were several very fine examples of combined sets of generating plant constructed for continuous, alternating, and polyphase current work; they were for the most part of the slow speed type, and occupied an enormous space per unit of output. English and American makers were poorly represented, but for the high speed sets it was very apparent that English manufacture was second to none.

Shoreditch.—The Lighting Committee, at a meeting of the Vestry on Tuesday, reported having considered the accounts of the electricity works and refuse destructor for the year ended March last, and recommended the Vestry to approve them. This was agreed to, and it was decided to transfer £1,000, out of the total net profit of £1,600, to the reserve fund, and to carry forward the balance of £600. On the recommendation of the committee, it was decided to sanction the purchase of 75 meters from Messrs. Venner & Co., at the rate of £4 10s. each.

Bermondsey.—The important combined scheme of electricity generation and dust destruction, arranged for the Vestry by Messrs. Kincaid, Waller & Manville, is now well on the way, and on Monday last a foundation stone tablet was laid by Mr. T. Cox, chairman of the E.L. Committee of the Vestry. A handsome trowel and mallet were presented to Mr. Cox by the engineers, Messrs. Kincaid, Waller and Manville, and the contractors, Messrs. Hughes & Stirling. After the ceremony, the company partook of light refreshments provided by the contractors, and an interesting hour was spent, during which addresses were delivered by several of the gentlemen taking part in the function.

Maidstone.—The R.D.C. has refused to allow Messrs. Stevens & Barker, electrical engineers, to carry a cable across the road in order to put down an electrical installation on the premises of Col. Boughton, of Cheveney, Hunton, unless it be laid underground.

Midland Electric Corporation.—At the quarterly meeting of the Staffordshire County Council last week, the clerk reported that notices of works under the E.L. Orders, 1898 and 1899, had been received from the above company with respect to roads in the districts of the U.D.C. of Amblecote, and of the R.D.C. of Kingswinford. The Corporation has also written to the U.D.C. of Bilston, stating that, in pursuance of orders obtained from it and the Willenhall Council, a number of the main streets in Bilston will shortly be taken up for the purpose of laying mains.

Monmouth.—A temporary failure of the electric light took place last week, owing, it is said, to a fault in the mains.

Mountain Ash.—The D.C. has appointed an E.L. Committee with a view to applying to the B. of T. for a prov. order for electric lighting.

North Metropolitan District.—The Southgate D.C. last week resolved to seal an agreement with Edmonton, Enfield, Southgate, Tottenham, and Wood Green District Councils for the promotion of a joint Bill in Parliament for constituting, incorporating, and conferring powers upon the joint board representing the said Councils to establish stations for generating and distributing electrical energy, to acquire land, and to borrow money for other purposes.

The Works Committee of the Edmonton D.C. has decided to give notice to the North Metropolitan Electric Power Supply Company of its intention of applying for a prov. order for electric lighting.

Paisley.—The T.C. has resolved to obtain additional borrowing powers to the extent of £25,000 for electric lighting purposes.

Peterborough.—The T.C. has decided to apply to the L.G.B. for leave to borrow £5,000 for the completion of the electricity works.

Radstock.—Owing to an increase in the price of gas, the D.C. has decided to obtain the views of the Midsomer Norton Council on establishing a joint electric lighting scheme for the two towns.

Rhondda Valley.—The D.C. has decided before the close of the year to seek powers to supply electric energy for public and private purposes within the urban district.

Rickmansworth.—The E.L. Committee of the D.C. lately recommended the Council to support the application of the Electric Light and Power Company for a prov. order, on satisfactory terms being arranged. The report was adopted.

Ripon.—The Corporation notifies its application for a provisional order in the *London Gazette* for October 30th.

Risca (Mon.).—At a recent meeting of the U.D.C. it was reported that the matter of having a joint electric scheme for Risca, Abercarn, and Abertillery was under consideration, and that a meeting of representatives of the three Councils is to be held.

St. Annes-on-the-Sea.—An attempt made some time ago by the local authority to purchase the gasworks failed; the gas company recently offered to sell to the D.C. the street lamps, to be used in connection with the proposed lighting of the thoroughfares by electricity, but the offer was declined, and now the company are advertising the said lamps. If a purchaser is found, presumably they will be pulled down, with the result that the town will be without light during the winter months, for the electric lighting scheme is far from being completed. There is a scheme now on foot for the incorporation of St. Annes with Blackpool, in which event the T.C. of Blackpool will take over the electric lighting undertaking and secure powers which involve the buying up of the local gas company. This proposal is, however, being strongly opposed in both towns.

St. Helens.—The borough electrical engineer, Mr. Highfield, has reported to the Electric Supply Committee that up to September 30th last the number of electric lamps connected was 15,727, the number at the corresponding period last year being 9,096. The number of units sold for lighting purposes during September was 12,087, against 8,207 in the corresponding period last year; the number of units sold for tramway purposes was 44,939, against 19,417 in September last year; and the number of units sold for power purposes was 7,874, against 971 last year.

St. Margaret's.—The Parish Council, having received from Mr. E. H. Shore formal notice of his intention to apply for power to construct electric light works at St. Margaret's, has decided to offer no obstacle to the proposal.

Siam.—The report of the Siam Electricity Company, Limited, for the half-year ended June 10th last states that the meter system has now been applied to a greater part of the system, with a reduction in the consumption of energy of 20 per cent., while the receipts have only diminished by 6 per cent. The Siamese Government has reduced the consumption in the Royal Palace to less than half under the new *régime*. An interim dividend of 4 per cent. for the half-year was declared at the third ordinary general meeting last month, and it was stated that the new machinery was expected to bring about a substantial saving.

Sleaford.—Mr. M. K. North, A.M.I.C.E., L.G.B. inspector, held a public inquiry at Sleaford last week into an application of the U.D.C. for sanction to borrow £7,000 for purposes of electric lighting. Mr. E. B. Smith, electrical engineer, Oswestry, produced estimates of the cost of plant. There was considerable opposition to the application on the part of the ratepayers.

Southampton.—The T.C. at the last meeting adopted the report of the Electricity Committee, recommending the supply of electric current to H.M. Ordnance Survey Department in that town at 2½d. per unit for power, and at the reduced sum of 2¼d. per unit for every unit consumed over and above 100,000 units in any one year, and that the charge for lighting purposes be fixed at 6d. per unit up to 10,000 units, and 5d. per unit if the consumption exceeds 10,000 units in any one year. It was also recommended that the charge to general customers for current for lighting purposes after March 31st next shall be 6d. per unit up to 10,000, subject to the usual rebate, and 5d. per unit, without rebate, if the consumption exceeds 10,000 units in any one year. It was resolved, on the recommendation of the Committee, to apply to the Local Government Board for sanction to borrow £12,000 for extension works already sanctioned by the Council.

Standish with Langtree.—The proposed application of the U.D.C. for a provisional order is filed in the *London Gazette* in the usual way.

Stratford-on-Avon.—The E.L. Committee has decided to apply for a prov. order to supply electricity for lighting and traction purposes within the borough.

Strokestown (Co. Roscommon).—A public meeting was held recently to consider the question of lighting, at which a proposal to introduce electricity was favourably received.

Stromness.—A movement is on foot to have Stromness lighted by electricity. It is believed that there is ample motive power in the new water supply, which has a very high pressure, and the gas being 7s. 6d. per 1,000 feet, and very bad at that, it is argued that a great saving would be effected by the introduction of electric light.

Stroud.—The action of the U.D.C. in deciding to oppose any private company who sought for powers to supply electricity in the town has been freely criticised, and it will be made one of the test questions when the whole of the Council seeks re-election next March.

Swindon.—The U.D.C. contemplates embarking on a scheme of electric lighting and tramways.

Sydney.—Messrs. Preece & Cardew had plans prepared for the electric light station for the City Council in Kent Street, when they received a cable to stop, as the Government had resumed the land. They have written strongly urging that the resumption be reconsidered in view of the purpose for which the land was intended. The matter is to be again brought before the Premier, but has been delayed because the Minister for Works is considering a big scheme of power transmission from the Nepean.

Wednesbury.—The question of providing the electric light for the borough, and of running the trams by electricity, is now engaging the attention of the Corporation. There is said to be a strong feeling in favour of leasing the lines to some company when the Corporation obtains possession of them, the company running them by electricity, while it is intended that the Corporation shall purchase electricity in bulk from the company working the trams, and be responsible itself for its distribution for lighting purposes throughout the town.

Woking.—The Woking Electric Supply Company, which charges 7d. per B.T.U., now offers discounts to large consumers. The company's powers for 42 years have been confirmed by the Board of Trade. The company has been invited to compete with the local gas company in providing the lighting of the public streets, and each company will erect a specimen of its lamps for comparison in one of the principal thoroughfares.

Wolverhampton.—The E.L. Committee of the Corporation has just prepared an important report embracing heavy expenditure, from which we extract the following:—"The maximum load at the works during the winter of 1899-1900 was 480 KW., and during the ensuing winter (1900-1901) this figure will be increased to at least 620 KW. The machinery at present installed at Commercial Road, and available for use this winter, has a capacity of 640 KW., exclusive of the storage battery, and your Committee have also on order two additional generating sets of 500 KW. each, one of which it is hoped will be in working order before Christmas, and the other shortly after. This will give a total generating capacity of 1,640 KW., of which, however, 500 KW. must be set aside as spare plant, leaving a working capacity of 1,140 KW. available for use on and after the end of January, 1901. As, however, the demand for electric lighting purposes increases at the rate of about 33 per cent. per annum, it is apparent that the load to be dealt with during the winter of 1901-1902 will be at least 830 KW., in addition to whatever power may be required to supply the electric tramways, of which it is quite possible a section may then be in operation. Assuming that the tramway load can be dealt with by one 500-KW. generating set in conjunction with the traction storage battery, and that a second 500-KW. set is provided to act as a stand-by to both the lighting and tramway systems, it will be seen that the additional plant required is equal to two 500-KW. sets similar to those now on order. This will bring the total generating capacity of the 500-volt lighting and traction plant to 2,640 KW., of which about 750 KW. will be spare plant available for emergencies. Your Committee have also included in their estimate the supply of economisers for the new boilers and also economisers for the additional boilers, and the provision of superheaters for all the boilers, both new and existing." The Committee therefore suggests that the Council should empower it to carry out extensions to the existing plant, &c., at a total cost of £58,943, of which amount £15,000 is estimated as being for extensions to the distributing system during the next two years, as it is confidently anticipated that the existing rate of extension of mains will be maintained if not exceeded.

Yorkshire.—A scheme, proposed by Messrs. Bennett and Ward-Thomas, of Manchester, for the establishment of a joint municipal power station to supply an area of 10 miles radius, including the townships of Beverley, Driffield, Cottingham, Hessle, Withernsea, Hornsea, and South Cave, is under the consideration of the District and Parish Councils concerned.

ELECTRIC TRACTION NOTES.

Ashton-under-Lyne.—Mr. G. R. Askwith, barrister, of London, has been appointed arbitrator by the Board of Trade in the electric railway strike. Mr. Askwith has intimated to Mr. Jackson, the men's secretary, that it would be advisable in the meantime for the whole of the men to return to work.

Belgium.—The scheme for the construction of an express electric railway between Brussels and Antwerp is again receiving consideration. According to the new project the starting point would be in the Place des Palais, Brussels, the line being underground as far as Schaerbeek, from which place it would run to Antwerp parallel to the State Railway. The line would be 43½ kilometres (27 miles) long, and this it is proposed to cover in 28 minutes. The estimated cost of the line is £2,000,000.

Birkenhead.—The Tramways Committee recommends the appointment of a tramways manager at a commencing salary of £300. Also that a tender from the Lorain Steel Company, Pennsylvania, for the supply of about 110 tons of steel tramway rails, be accepted.

Bradford.—At a meeting of the Tramways Committee last week, Alderman Cowgill presiding, the returns showing the results of the working of the electric tramways for the week ended October 21st, 1900, were presented. On the Bolton section 3,094 miles have been run, and the receipts amount to £130 11s., which is equal to 10·12d. per car-mile. The workmen's checks issued numbered 1,548, and 1,506 have been returned. The total receipts since April 1st, 1900, amount to £4,445 15s. 8d., or 11·44d. per car-mile. On the Horton section during the past week 6,329 miles were run, and the receipts were £266 9s. 9d., which is equal to 10·10d. per car-mile. The workmen's checks issued numbered 1,762, and 1,720 were returned. The total receipts since April 1st, 1900, amount to £9,638 11s. 5d., which is equal to 12·18d. per car-mile. On the Lidget Green section, during the week 2,640 miles have been run, and the receipts were £118 17s. 6d, which is equal to 10·8d. per car-mile. The total receipts since the opening of the line amount to £1,008 16s. 5d., which is equal to 11·76d. per car-mile.

The Board of Trade inspection was to take place yesterday of the new tram routes in Bradford—Westgate to Toller Lane and Thornbury to Stanningley. The extension to Stanningley was tested on 24th ult., when one of the electric cars performed a successful initial trip to the Leeds city boundary at Stanningley. The committee hopes to have a regular service of cars running in two or three weeks. The cause of the delay is the want of a depôt at Thornbury, where a shed is to be erected capable of holding 100 cars. It will form the central depôt for the Corporation tramways.

Cardiff.—The contracts for the electric tramway power house, &c., have been placed, and are mentioned under "Contracts Closed" this week.

Carlisle.—An overhead tramway wire broke down on 25th ult., and there is a tale about electrical effects upon a collie dog and a bullock which chanced that way.

Darlington.—On Monday a special meeting of the T.C. was held to consider the draft observations and objections to the draft of the provisional order of the Light Railway Commissioners as approved by the Tramways Committee.

Dundalk.—The Dundalk Electric Tramway Company has applied for further time for the completion of its lines, and the Privy Council sitting at Dublin Castle last week decided to recommend the granting of the extension. The order made in 1897 limited the completion to three years. Subsequently it was thought wise to combine lighting with the tramway undertaking, and a London electrical engineer was asked to report, with the result that it was shown that the two things could not be worked independently with success. It was thus thought advisable that the promoters of the two schemes should jointly carry them out. An agreement was entered into with Messrs. Drake & Gorham to carry out the works early this year, but on August 1st they informed the promoters that the increased cost of iron and coal prevented their carrying out the contract. Therefore an extension of two years under the order has been asked for, and is likely to be granted as there was no opposition.

France.—It is proposed to hold another competition for electric accumulators for motor cars in June next, under the auspices of the French Automobile Club.

Gloucester.—With regard to the proposed acquisition of the tramways by the Corporation, and the conversion of the same into an electric tramway, a meeting to take up the consideration of the matter will be held in the middle of December. In consequence of the extension of the city boundaries, the whole of the Council has been re-elected, and the number of representatives increased; considerable local interest is being evinced as to the policy the new Council will adopt on the tramways question.

Hungary.—Some experiments with the Cecchi system of electric traction, using high pressure polyphase current, were carried out recently at the works of Messrs. Ganz & Co. at Buda-Pesth, in the presence of the Austrian Minister of Railways and a large number of experts.

Italy.—The following are some particulars concerning a projected new line in Italy, for which only two new sections are required to complete the same from Genoa to the south-eastern side of Mont Blanc. A pretty full description of one of the sections has appeared from the pen of Colonel Alberto Ara, late of the Royal Italian Artillery, in the *Gazzetta del Popolo*; it relates specially to a project of Engineer Rossi, of Genoa, who has projected a short line of about 43 kilometres from Asti to Chivasso, which would form a part of the main line from Genoa through the Val d'Aosta up to the town of that name, which length of line would be subsidised by the State to the extent of 5,000 lire per kilometre, for a period of 70 years, with a lump sum of 500,000 lire from the town of Asti. The proposed 43 kilometres from Asti to Chivasso would shorten the distance between Aosta and Genoa by 34 kilometres. Similarly, Engineer Cedale, of Aosta, has projected an extension of the present Valle d'Aosta line from Aosta to St. Didier, on the other side of Mont Blanc, which would be similarly subsidised, except that possibly the town of Aosta would not be able to make such a large capital grant. It is proposed to tunnel under Mont Blanc and make a junction with the extension of the P.L.M. line, now being carried up into the Chamonix Valley. The maximum elevation above sea level at any point is only 1,000 metres, while the distance from St. Didier to Chamonix is only 16 kilometres, of which about 13 would be in a tunnel. It is proposed that, by taking advantage of the abundant water power on both sides of the mountain, the tunnel section should be worked electrically, thus avoiding the suffocating sensation arising from the use of sulphurous coal as in the locomotives drawing trains through the St. Gothard and Mont Cenis Tunnels, from which travellers so often suffer. Originally it was intended that the extension from St. Didier should be made into Martigny, thence connecting with the Rhone Valley line, but as this line will be connected with the Simplon Tunnel route when completed, it was thought better to vary the route of the proposed direct line to Genoa, so as to obtain for it the heavy tourist traffic to the neighbourhood of Mont Blanc and the Chamonix Valley passing by way of Geneva. Besides, the distance by this route between Paris and Genoa will be considerably shortened by the proposed deviation from the original plan, and by opening up a new and shorter route to the North of Italy, there is sure to be an enormous traffic to the beautiful Valle d'Aosta, which is at present only accessible by passing down to the southward through the Mont Cenis Tunnel and returning northward by train from Turin, a journey of some five hours' duration, which has to be again repeated before the traveller can regain one of the main lines leading back into France or Switzerland. Apart from this holiday passenger traffic, it must be remembered that Genoa is now the most important port in Italy, if not in the whole of the Mediterranean, and the business and goods traffic should therefore be heavy. Undoubtedly, when finished, the P.L.M. line would run through trains from Paris to Genoa, and probably, as in the case of through traffic to Nice and Ventimiglia, through carriages would be run from Calais to the Mediterranean.

Limerick.—Last October, in the face of a good deal of popular opposition, a scheme was passed for passenger traffic and goods haulage by electricity, but the latter part of the proposed scheme was so unpopular, on the ground that its adoption would take away the means of livelihood from a large body of carters, and that other interests would suffer, that it had to be abandoned. During the discussion the Mayor (who favoured the project) had to receive police protection on his way to and from the Council meetings. Now, however, it is said that the scheme will be proceeded with, after lying in abeyance for over 12 months.

Liverpool.—On Monday afternoon a span of supporting wire, which was attached to a building on the Pier head, the river terminus of the electric tram system, gave way, with the result that two main conducting overhead wires fell down, interrupting the working of a portion of the system for an hour.

Llanelly.—There was a sitting of the Light Railway Commissioners at Llanelly on Thursday last week to hear an application for an order by the Llanelly and District Electric Lighting and Traction Company. In stating the case on behalf of the promoters, Mr. Page, Q.C., explained that there was no substantial amount of opposition to the order which was being applied for, and any opposition that was offered had reference merely to clauses. The promoters of this order were the Llanelly and District Electric Lighting and Traction Company, which was incorporated on November 29th, 1899. The object of the order was the relaying of the tramway now belonging to an independent company in Llanelly, and also the extension of that tramway in four directions. The existing tramway was rather more than a mile in length, but under this scheme it would be extended to 7 miles 6 furlongs 2 chains. This application was the result of a desire on the part of the Borough Council, and the tramways were to be extended to meet that desire. Last year the Council came into communication with the British Insulated Wire Company, which had a very large amount of capital, and carried on its business in Prescot. An agreement was entered into on December 4th of last year, whereby it was provided that this company or its nominees should apply for the provisional order for the supply of electricity to be transferred to it, and also for the construction of a proper tramway system. It was provided that either the British Insulated Wire Company should carry this out, or a subsidiary company should do it for them. In consequence of that arrangement this Llanelly and District Company had been formed, and the B.I.W. Company was prepared to give a guarantee of the ability of the promoters of this order to carry it out if they were empowered by the Commissioners. The total capital proposed was £50,000, which was considerably in excess of the amount expected to be spent on the line. Taken altogether, the total population to be served ran close to 40,000, of which Llanelly was the central town. It was, in fact, the only market town of the district. Arrangements had now been made by which the tramway had been transferred to the promoters of this order. The gauge of the existing tramway was 3 feet, while the new one would have a gauge of 3 feet 6 inches. The system was the overhead trolley system, which was the one most generally adopted in this country. The cost of construction would be £35,000, and it was estimated, having regard to the population to be served, that they could fairly count upon earning £8,000 a year. Allowing 50 per cent. for working expenses, that left a sum of £4,000 profit, which would be ample to pay a substantial dividend. All the local authorities approved of the scheme, and arrangements had been made by the Borough Council by which workmen's cars at cheap fares would be run. One great advantage of the scheme was that there would be two lines connected with the Great Western Railway station, which was far removed from the centre of the town. The line would be laid all through on the high road, and it was not proposed to make any compulsory purchase of land.

The chairman then said that the Commissioners were of opinion that the scheme was a very satisfactory one, and they would be pleased to recommend the application that had been made.

Manchester and Liverpool Electric Railway.—Surveys have again been made in the meadows between Eccles and Barton for the line of the electric express railway prior to the Bill being deposited in the House of Commons.

Oldham.—The sanction of the Board of Trade to the borrowing of £280,000 by the Corporation in respect to the electric tramway undertaking has just been received.

Paisley.—The T.C. held a special meeting on Monday to consider the rival electric traction schemes. Earlier in the day Mr. Murphy, of Dublin, spoke at a meeting of ratepayers on the same subject, and explained the changes he proposed making in the Bill of the Paisley District Tramways Company, which was rejected last year. He partly blamed the clauses affecting the local authorities, of which there are several in the proposed area, making the scheme unworkable. He now proposed that all the clauses should apply equally to all the local authorities concerned, and suggested meeting a representative from each to arrange matters. In his new Bill the local authorities would have the right to purchase the tramways as a whole at the end of 25 years at a fair market value. With regard to the electric power station of the Paisley Corporation, Mr. Murphy said he was willing to negotiate with the Corporation with a view to purchase. At the Council meeting, Bailie Bell thought Mr. Murphy had been badly advised in holding this ratepayers' meeting. He moved that the Corporation go on with the preliminary steps with a view to Corporation control. Ex-Provost Clark moved the previous question. On a division, there was an equality of votes. After much discussion it was agreed to take a poll of the ratepayers on Saturday, November 3rd, the question to be asked being "Corporation" or "Private" control.

Plymouth.—On the morning of the 24th ult. an overhead wire, presumably a guard wire, broke down in Tothill Road. The tram service appears to have been delayed about half-an-hour. The *Western Morning News* says: "The effects of the electrical current can be plainly seen on the tram rails and the paving stones adjoining"!

Portsmouth.—On Monday, in the presence of a number of members of the Corporation and other influential townsmen, as well as of the Mayoress and several ladies, the Mayor of Portsmouth (Mr. Harold Pink) laid the foundation stone of the electric tramways power station. The power station, which is situate at Fratton, is to be 116 feet long, 49 feet wide, and 28 feet high. It will contain three engines of the horizontal Corliss type, two being side-by-side compounds of 640-H.P. each, and the third a tandem compound of half the power of the others. The engines are to be by Messrs. Yates & Thom, of Blackburn. The electric generators, of the usual engine type, are to have the armature in each case mounted directly upon the crankshaft of the engine. The dynamos will be made by the English Electric Manufacturing Company, Preston. In the engine room will also be erected condensers with independently-driven pumps, and an overhead travelling crane capable of lifting 25 tons. There will be ample space for a fourth engine. Water-cooling towers are to be used in connection with the surface condensers. The condensing plant will be supplied by the Worthington Company, London, and the pipework by the Alton Company, London. The roof of the building is to be formed by a large cast-iron water tank, capable of holding 25,000 gallons. The chimney shaft is to be 126 feet high, with an inside diameter of 6 feet 6 inches. In the boiler room will be three Babcock & Wilcox water-tube boilers, each of sufficient capacity to run one of the large engines. A Green's economiser is to be provided in connection with the boilers, which will also be fitted with steam superheaters. Space is provided for a fourth boiler, and also for an additional economiser. The station has been designed by Mr. Rotter, the engineer in charge of the tramway works. The contract price of the building is £10,515, and the machinery will cost £29,656. The contract time for the completion of the structure is nine months from its commencement.

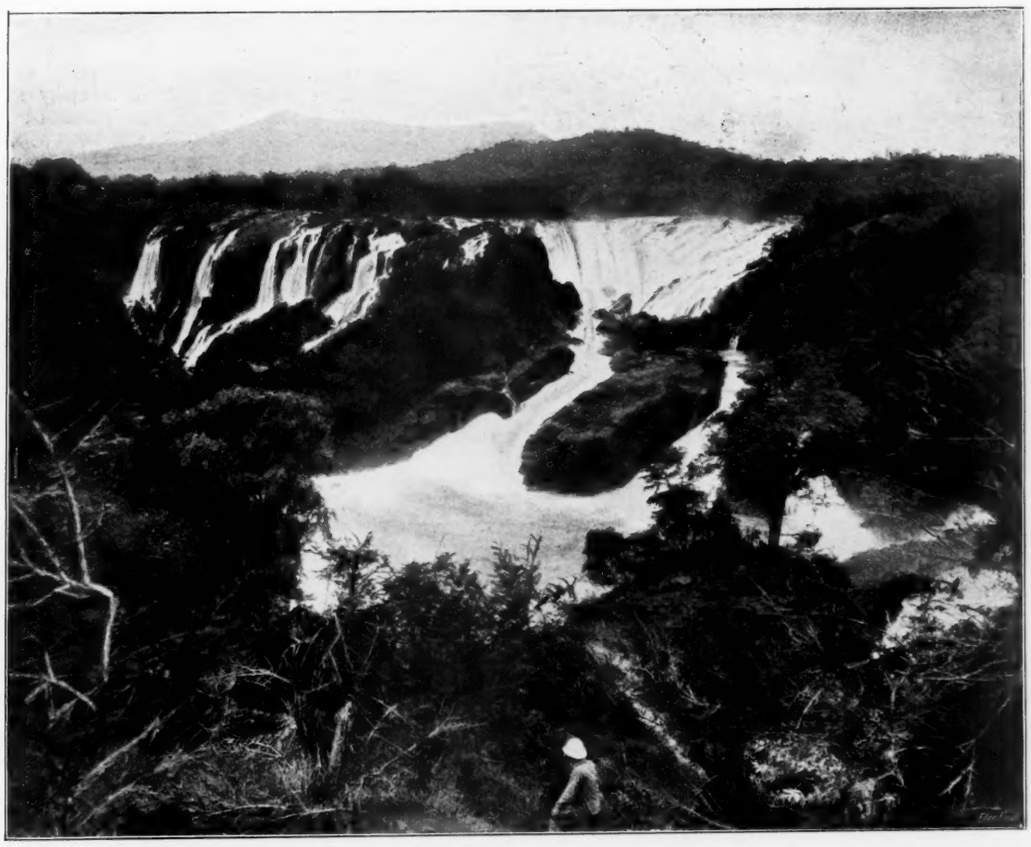
(*Continued on page* 713.)

ELECTRICAL DEVELOPMENT SCHEMES IN INDIA.

In course of time no doubt the rivers of India will be made to render great service in connection with the various industries, by being utilised for the generation of electrical energy for lighting, traction, and power work. The proposal to make use of the great force of the Jhelum River and its series of gorges for the operation of a 2 feet 6 inches gauge electric railway from Jummu to Srinagar, a distance of 180 miles, is already familiar to our readers.*

Another proposition, which was stated to be in the hands of a London syndicate, was the Simla water-power scheme, utilising the waters of the Sutlej River for the operation of turbines for electrically working the Kranga Valley Railway, the North-Western Railway, and partly the Simla-Kalka Railway, certain power for lighting and other purposes being conveyed to Lahore and Simla. This is some miles to the south of the area affected by the Kashmir scheme, but both sources are well within the mountainous Himalaya tract.

Doubtless numerous other schemes of a similar kind have been suggested or drawn up, but so far as we are aware, practical operations have only been commenced upon one undertaking; we refer to that for whose purpose the Cauvery Falls are to furnish the power, and for which, may we significantly add, the large electrical machinery and equipment contracts are to be carried out by American electrical works. Of course, we are all desirous that India should secure at the earliest possible moment all the benefits which electrical science and engineering are able to confer upon her in the development of that vast continent by the up-to-date utilisation of her natural forces; but even while bearing that desirability in mind, we should be exceedingly sorry to see work of such enormous importance and of so vast a nature taken possession of by other than English manufacturers. There may once have been a valid reason for the execution of English tramway station machinery orders by American houses, but at the end of the century when there is unmistakable evidence of English manufacturers having pulled themselves together, and set their works in order, the requirements of these foreign countries must not be disregarded. It is not up-to-date enterprise which allows a man to sit down satisfied because his books are full of orders, and his works are doing overtime. He must pull down his old barns and build greater, if we may quote a scriptural phrase, without applying the full meaning of its original context. To fail to bestow the proper attention upon the electrical development of any of our Colonies or dependencies, particularly India, Africa and Australasia is tantamount to giving a hearty invitation to more enterprising engineers and manufacturers of other nationalities to enter into the land of promise and carry off the spoils. How meekly should we follow after them to gather up the crumbs that fell from the rich man's table! We must look not only to the English manufacturer and his representatives to watch our national electrical interests; the engineer, the exploiter, and the promoter, must precede him making straight the rough places. Are English electrical engineers doing all in their power in this direction? We are tempted



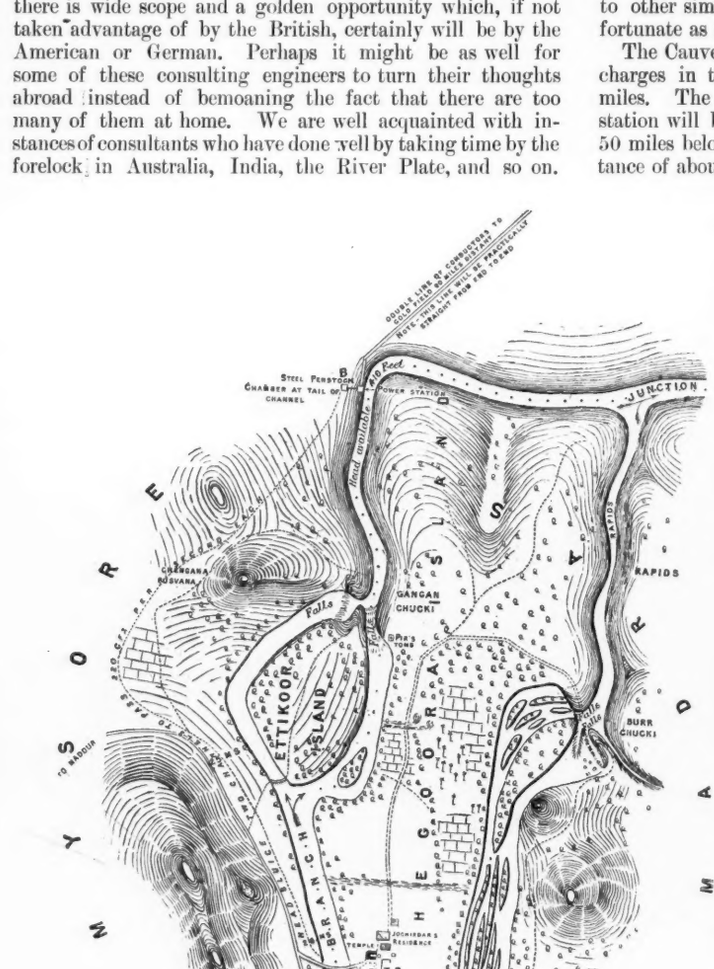
Burr Chucki-Sivasumudaram Falls of the Cauvery.

* Electrical Review, September 8th, 1899.

of one failing, the remaining line will be sufficient to carry

slotted armature type with revolving field, either on one bed-

to believe not. In the promotion of home schemes their name is legion, and too often they are to be met with tumbling one across the path of another in the pursuance of rival interests, scrambling for the next job, Mr. Wellknown and Mr. Littleknown seeing who can underquote the other for preparing a report, most of which is already filed in well-stocked pigeon holes. We have no intention to undervalue these home development works, but we do think that abroad there is wide scope and a golden opportunity which, if not taken advantage of by the British, certainly will be by the American or German. Perhaps it might be as well for some of these consulting engineers to turn their thoughts abroad instead of bemoaning the fact that there are too many of them at home. We are well acquainted with instances of consultants who have done well by taking time by the forelock in Australia, India, the River Plate, and so on.



If more of this kind of thing be not done we may expect repeatedly to hear of American engineers drawing up electrical engineering schemes for British and Colonial territory and American manufacturers supplying all the machinery. Why not English engineers and English manufacturers?

However, to revert to the Cauvery Falls installation, this is being carried out by Americans, and it is the first actual scheme which has been definitely settled in India. The credit for being thus first in the field to utilise natural Indian waterfalls for the assistance of industry is due to the State of Mysore, but the American manufacturers are also first in the field for works of this character, and they will doubtless feel the beneficial effect of this when subsequent proposals are brought forward. We understand that the conception of the Cauvery Falls project is due to Major A. J. de Lotbiniere, R.E., and to Col. Robertson, chief of the State Public Works Department.

For the following particulars of the scheme, as well as for the accompanying photograph of the Falls themselves, we are indebted to our contemporary, the *Indian and Eastern Engineer*.

The power is to be utilised for working the goldfields of the Kolar district of Mysore, and it "must undoubtedly lead to other similar developments in territories which are not so fortunate as to be subject to the Mysore Durbar."

The Cauvery River rises in the Western Ghauts and discharges in the Bay of Bengal, after a course of some 475 miles. The Falls of the Cauvery, at which the generating station will be situate, are at Sivasumadarum Island, some 50 miles below Seringapatam, of famous memory, and a distance of about 93 miles across country from Kolar, the centre of the Mysore gold mining industry, where the power is to be applied.

The discharge required to generate sufficient power at the Falls to transmit and deliver 4,000 H.P. at the Kolar goldfields has been found to be 181 cubic feet per second, and observations have shown that even in the dryest month of the dryest season on record, the quantity required is easily available. The actual horse-power generated at the Falls power station will be 5,970, and an allowance of 33 per cent. has been made for loss during transit. The lithograph published with this article gives a plan of the works at the generating station, the whole of which will be in Mysore territory, with the exception of the two low dams, which will be partly in Mysore and partly in Madras territory.

It is proposed to erect a low dam at w x, which will serve to divert the dry-weather flow of the river into the western branch. Across this western branch at A, a low anicut, or dam, will be erected. This dam will serve as a barrier during the dry weather only, and will not form an obstacle to the passage of flood water. Two channels will take off from the left flank of the anicut sufficient to carry 220 cubic feet per second each. It has been considered advisable to build two channels once and for all, as the works will be enlarged in all probability soon after completion.

These channels, which will be in excavation throughout their length of $3\frac{1}{3}$ miles, terminate at the point B, which is a high bluff overlooking the river. From the tail of the channel three steel pipes 36 inches in diameter will carry the supply of water under pressure to the generating station, which will be situated on the margin of the river, 6 feet above highest flood level, and 410 below the tail of the channel. Three pipes or penstocks are employed, in place of one, to obviate all risks of accidents. Two pipes alone are sufficient to carry the necessary water. They will be fitted up with all the latest devices to ensure satisfactory working, such as air and vacuum valves and relief valves, and the lengths from which they will be built will be rivetted together at site. The plates will be graduated in thickness, the heavier ones being at the bottom of the bluff.

The generators will consist of six complete units of 1,000 H.P. each, each unit comprising a water-wheel and generator on a horizontal shaft. The generators will work at 2,200 volts. Step-up transformers will be employed to raise the voltage from 2,200 to 30,000. At the receiving end of the line, step-down transformers will reduce this voltage to 4,000 for distribution purposes. At each mine secondary transformers will be employed to still further reduce the voltage to between 150 and 200.

The transmission line will be in duplicate; two sets of poles, each carrying three wires. As a rule, both lines will be used, each line taking half the current, but in the event

supplied by Government); two independent copper transmission

The winding of the armature consists of large copper bars

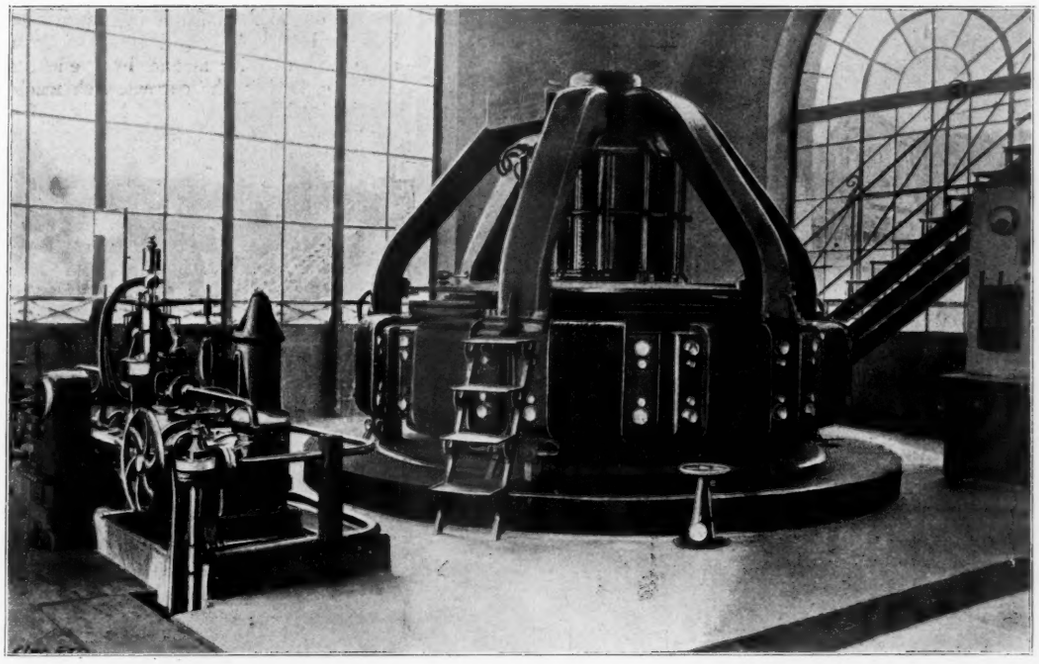
of one failing, the remaining line will be sufficient to carry the whole current. In order to reduce the line loss to a minimum, change-over stations will be provided at 30-mile intervals. These stations will enable sections of the line to be thrown out of operation for repair at any time, without interfering with the remaining portions of the same line. For instance, if an insulator failed at mile 35 out, on No. 1 line, the section in which this insulator happened to be would be cut out, and the ends of sections Nos. 1 and 3 of line No. 1 would be connected with No. 2 line at both ends. The current carried by No. 1 line would then travel over No. 1 for 30 miles, cross over to No. 2 from the 30th to 60th mile, and then back to No. 1 from 60th mile to the end. The result would be increased line loss due to one-third of No. 1 line being out of operation only. Without change-over stations, if one line were cut out for repairs, and the whole current carried on the other, the line loss would be doubled. Ordinarily each line will carry half the current with a loss of a little over 13 per cent.

The contractors for the generating plant and transmission lines are the General Electric Company, of Schenectady, U.S.A. The turbines (modified Pelton wheels) are to be slotted armature type with revolving field, either on one bedplate with the turbine or separate. The armature will be tested for one minute with an alternating pressure of 5,000 volts, the working pressure being 2,200 volts. The efficiency claimed is high, namely, 96 per cent. at full load. The armature is made to slide off parallel to the axis for repair.

The voltage proposed for the exciters is only 60 volts. This low voltage is proposed in order to enable a strip winding to be used on the generator field magnets, giving an advantage in reducing the bulk of the field coils and also reducing their temperature, both on account of the reduced bulk, and of one edge of the strip being exposed to the air.

Moderate sized single-phase units are proposed, and either air-blast or water-cooled oil transformers are specified.

The lightning arresters proposed consist of a number of metallic balls with air gaps in between, and put in series with a graphite resistance. They depend for their action in extinguishing the arc formed on the cooling effect of the masses of metal combined with the reduced current due to the resistance. They are said to have been used successfully in a large number of installations.



Electricity Works at Chèvres: Thury Continuous Current Generator.

supplied by Messrs. Escher, Wyss & Co., of Zurich, and it is provided in the agreement with the contractors that the water-wheels for driving the generators shall each deliver to the corresponding generator shaft under normal conditions 1,015 B.H.P., and a maximum of 1,260 B.H.P. The water-wheels for driving the exciters shall each deliver under normal conditions 110 B.H.P. The regulation of the water-wheels to be as follows:—If 25 per cent. of the full normal load be thrown off or on instantaneously, the increase or decrease in speed not to exceed 3 per cent. of normal speed. If 50 per cent. of full normal load be thrown off or on instantaneously, the increase or decrease in speed will not be greater than 5 per cent. of the normal speed. If the full normal load be thrown off or on instantaneously, the increase or decrease in speed will not exceed 10 per cent. of the normal speed. Furthermore, the governors shall not race under sudden variations of load, and in steady or gradually changing loads they shall not allow a variation in speed of more than 1 per cent. from the normal.

A number of leading electrical manufacturing firms sent in their proposals for the scheme, that of the General Electric Company, of America, as we have already stated, being accepted. In their scheme the generator proposed is of the stationary

The wire specified is No. 0 B. and S. gauge, having a diameter of 0·32495 inch, and a section of about 0·829 square inch, with a weight of 322·5 lbs. per 1,000. The total weight would be about 410 tons.

The plant to be supplied by the General Electric Company is as follows:—

6 generators of 720 KW. capacity each; 2 exciters of 75 KW. capacity each; 12 step-up air blast transformers, 400 KW. each; 12 step-down air blast transformers, 350 KW. each; 4 blower sets for cooling step-up and step-down transformers; 1 electrically-driven air compressor and reservoir for blowing dust from generators; 2 air compressors for blowing dust from switchboards in the two transformer stations; 1 switchboard for generating station; 1 switchboard for step-up transformer station; 1 switchboard for step-down transformer station; 8 switchboard panels for section houses; 3 hand-power cranes—1 each for generating, step-up transformer, and step-down transformer stations; lightning arresters for step-up and step-down transformer stations, and also for two intermediate points on the line; 6 tachometers for indicating the speed of the generators; necessary material and supplies for lighting, generating, and step-up and step-down transformer stations to the extent of 50 16-C.P. incandescent lamps in each station; suitable wiring and cables for the generating station, the step-up and step-down transformer stations, together with suitable iron conduit for containing wiring and cables where advisable; poles for the transmission line according to the survey and the distance thereon specified, not to exceed 93 miles; insulators, pins, cross-arm clamps, and miscellaneous supplies for the poles (cross-arms to be

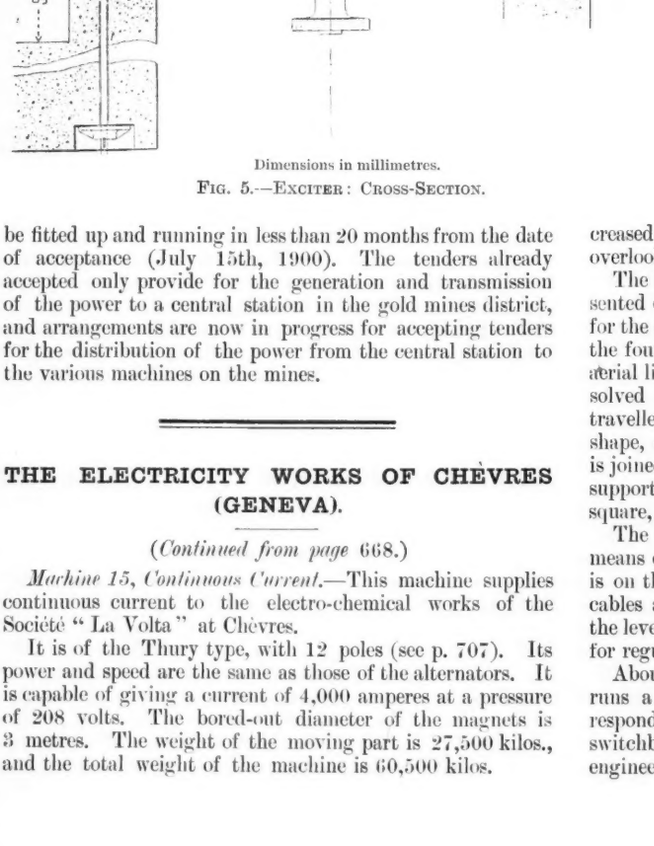
Finally, a top stage supports the structure whence the

in the middle is the tramway, and along the other side the

supplied by Government); two independent copper transmission lines strung on opposite sides of the poles. The section of copper wire will be equivalent to No. 0 Brown & Sharp gauge, and each line will have three conductors; metallic circuit telephone line consisting of two hard-drawn copper wires of ·005199 square inch in the section. Glass insulators for telephone line together with telephone instruments in the generating, step-up and step-down transformer stations and lightning arrester stations. Suitable stubs, guy wire and tying-in wire for the transmission lines. Spare parts for the generators, exciter, switchboard, transformers, and spare cable.

The General Electric Company's contract price amounts to £140,941.

The scheme is at present at the following stage. The sanction of the Government of India has been obtained. An arrangement has been entered into by the Government of Mysore with the Government of Madras for the supply of water in the Cauvery River. Tenders for the execution of the necessary works in India have been accepted, and the collection of materials and the excavation of the channels begun. Agreements have been entered into for the supply of the generating and transmission plant, and with the various mining companies for the supply of electrical power. The tenders for the plant stipulated that the whole should



Dimensions in millimetres.

Fig. 5.—Exciter: Cross-Section.

be fitted up and running in less than 20 months from the date of acceptance (July 15th, 1900). The tenders already accepted only provide for the generation and transmission of the power to a central station in the gold mines district, and arrangements are now in progress for accepting tenders for the distribution of the power from the central station to the various machines on the mines.

THE ELECTRICITY WORKS OF CHÈVRES (GENEVA).

(*Continued from page* 668.)

Machine 15, Continuous Current.—This machine supplies continuous current to the electro-chemical works of the Société "La Volta" at Chèvres.

It is of the Thury type, with 12 poles (see p. 707). Its power and speed are the same as those of the alternators. It is capable of giving a current of 4,000 amperes at a pressure of 208 volts. The bored-out diameter of the magnets is 3 metres. The weight of the moving part is 27,500 kilos., and the total weight of the machine is 60,500 kilos.

The winding of the armature consists of large copper bars sunk in semi-open grooves, in such a manner that it is not necessary to secure them by bands.

The current is collected by carbon brushes on a commutator 1 metre in diameter. In order to facilitate the upkeep and examination of the commutator, each brush-holder can be taken off independently of the others, and all the brush-holders on the same spindle can be removed from the commutator at the same time.

The machine is also provided with a hand brake in order that it can be stopped, even if the gate of the turbine is not altogether closed.

The Exciters.

The exciting dynamos (fig. 5), to the number of three, were made by the Oerlikon Works; they are designed for an output of 750 amperes and 115 volts, at 150 revolutions per minute. They are continuous current machines with six poles, and the armatures are coupled direct to the turbine shafts. Each dynamo constitutes an independent machine, having one principal lower bearing and one higher guide bearing. The shaft is bored in the vertical direction, and by this means the principal bearing is lubricated from above.

The armature is drum wound by means of bars of copper fixed firmly in the slots of the laminated iron core, and insulated from the same in an effective manner by tape and mica.

For collecting the current, each machine is provided with six series of brushes, of which each comprises three brushes; the commutator is of hard copper; the magnetic field, of mild cast-steel, is six-polar, and is excited by a compound winding.

Switchboard.

In order to simplify the station at Chèvres, and to permit of the easy controlling of the units, a special arrangement of boards has been found necessary; these boards were supplied and erected by Messrs. Brown, Boveri & Co., at the same time as their generators.

The installation comprises a series of small boards, each controlling one of the new generators, and one large general board receiving the current of all the generators of the station, and distributing it to the various feeders.

The small boards, called *tableaux de connexion*, are placed opposite the generators which they control; they comprise marble panels, carrying two ammeters, which indicate the current in each phase, and a two-way switch for sending the currents from the machine into a special feeder, or to the large central board. In order to receive the latter board and its apparatus, the width of the building facing alternators Nos. 6, 7, 8 and 9 has been increased by 3 metres, by the construction of a bay which overlooks the tail race.

The building of this bay, which is 30 metres long, presented certain difficulties, owing partly to the room required for the overhead crane and its load of 30 tons, and partly to the foundation to be given to the structure from which the aerial lines start. The use exclusively of concrete and iron solved these difficulties satisfactorily. The rails of the traveller rest on a beam of strengthened concrete of a special shape, designed for carrying a load of 30 tons. This beam is joined at its ends to the wall of the building; it is also supported by three columns of strengthened concrete 35 cms. square, placed 7·5 metres from centre to centre.

The height of the bay is divided into four stages by means of beams of strengthened concrete. The lowest stage is on the subsoil level; this space is used for the low tension cables and the lightning arresters. The stage above is on the level of the machinery room; here are placed the rheostats for regulating the alternators, and the high tension cables.

About 2·8 metres above the floor of the machinery room runs a gallery intended for the public. This gallery corresponds to the ceiling of the first floor, and supports the switchboard proper, where the controlling is done. The engineer controls from his post here the whole machinery room.

Finally, a top stage supports the structure whence the overhead lines depart. This structure has a rectangular section of 5 × 3 metres and a height of 10 metres; it is made of iron and covered partly with xylonite and partly with painted sheet-iron. The different stages communicate with each other and with the machinery room by an iron staircase.

(*To be continued.*)

THE WORKS OF LUDW. LOEWE & CO., BERLIN.

(*Continued from page* 671.)

We need not say much of the polishing department. It is the same as the rest of the works, clean and orderly and well lighted, and supplied with fan-exhausted pipes to carry off the dust of the operation. Polishing is an operation that only applies to such articles as hand wheels, handles, and cone pulleys. No absolute mechanical accuracy is needed on things like handles. They are simply polished.

One of the most important of modern methods is the jig system. A jig is a specially-formed plate, bracket, or box which holds an article to be drilled or bored in perhaps half a dozen or more places. The jig is accurately made to receive the piece, and it has projections on it which are true, and on these the jig rests upon the table of the machine tool. The work is then completed by simply passing the required drills and reamers through the holes in the jig and through the piece to be machined. We have in mind the jig for holding the apron of a lathe, a piece in which there are many holes to be bored. The holes in the jig are fitted with hardened bushes. Any piece wanting frequent fixing requires a jig to cheapen its production. Of course, all these jigs and fixtures cost money, but they are the only means by which good work can be turned our cheaply. The making of jigs and fixtures is so important that a separate department is devoted to it with its full lines of various tools.

Fig. 7.

The inspection department is, of course, one of the essentials of such a works as this. All parts are duly inspected, the inspecting department having full sets of all the necessary gauges. Similarly, parts for stock are inspected and sent to the stores, whence they are drawn direct and accurate for assemblage in some machine, which can very quickly be delivered to order when all its parts lie finished in the stores.

Inspecting is not well carried out in most shops. All details should be inspected as finished, and this inspection should be excellent and complete, or the erection department will suffer. Good detail inspection renders final inspection much simpler.

The steel store contains bars of all the sizes necessary, and in it are machines for cutting the bars to lengths accurately, and with a minimum of loss, ready for the processes of the machine shop.

The smithy is shown in fig. 7. It is an almost ideal smithy for light work. Lofty and clean, and with all the forges well exhausted by pipes and fans in the manner shown. Along one side are ranged the forges and anvils; in the middle is the tramway, and along the other side the drop hammers.

The smithy is in the same building as the steel store, and adjoining it is the hardening and tempering room. Here are lead baths for heating, and tanks for quenching in oil, brine, or water. Everything is done here to known temperatures; pieces are thus finished unspoiled, and there is no dependence on special skill. Both water and oil are employed for quenching, and there are draught hoods to carry off the oil fumes.

After the hardening process few articles are found to be quite straight and unwarped. We note a special press in which reamers are straightened after coming from the hardeners. Before leaving the subject of the machine shops, we might point out one or two facts that go to swell the total that is made up into one fine system. In the planer shop the tools are alternately end for end; this puts two working sides together for one man to attend to. In circular milling of wheels one man easily attends five machines, and one man can look after two accurate grinding machines. The machine-testing department is not part of the manufacturing business; it comes under the administration side. The sale of machines is effected by administration, and so it appears right and proper that a sort of rival to the factory should keep a check on the factory, and maintain it in efficient order by having the power to reject its products, if not up to quality. This also prevents the administration from throwing all blame on the factory should anything go wrong, as must happen, even in the most perfect work, sometimes.

We notice a neat little tool by Brown and Sharpe for testing circularity, the error being multiplied by a long pointer. Those who may still doubt the relative truth of turned and of ground work, ought to watch a few tests with this little machine. We illustrate this in fig. 8.

The accompanying form is a copy of one of the test sheets of a lathe. These and similar sheets are got up for all machines. They contain one column for the limit of error that is allowed, and a second column for the error found. If not up to the required standard of accuracy, the machine in question would be returned with the sheet for correction by the manufacturing department.

Engine Lathe with Lead Screw.
Order No. 1,502, Mod. No. 2, Manuf. No. 15,354.

——	Allowance of error.	Real error.
Taper in spindle can be out of true	$\frac{1}{10000}$ of 1 inch in 12 inches	0·0004
Head stock spindle to V-ways of bed can be out of line:—		
Horizontal	$\frac{1}{10000}$ of 1 inch	0·0004
Vertical	in 12 inches	0·0006
Tail stock spindle to V-ways of bed can be out of line:—		
Horizontal	do. do.	0·0002
Vertical	do. do.	0·0006
Facing.—By facing a disc of 16 inches diameter, tool cuts:—		
Concave	...	0·0009
Convex	...	0·004
Lathe centres out of true change gears	0·0004	exact in order.

Date, *July 12th*, 1900.

In fig. 9 we illustrate a neat shop stand for holding tools and packings for planers, &c. Another neat stand noticed was a rack for bolts, consisting of several parallel bars of I section attached to a shelf and spaced to take the shanks of the bolts between the flanges, the bolt heads resting on the flanges, and each size of bolt having its own row. A stand will have two shelves of 15 rows each, the shorter ones above and the long ones below. The time saved by this device alone must be enormous, as compared with the

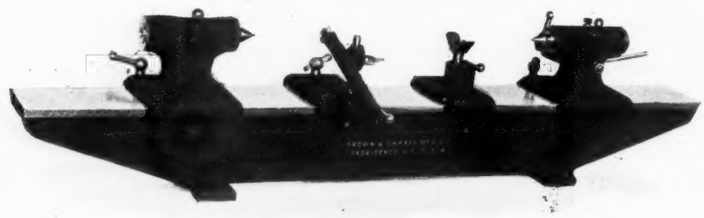


Fig. 8.

old system of hunting up old dirty bolts from under an equally dirty bench, and then having to run the nut up and down in a vice to clear off the burrs made last time the bolt was thrown down upon its hard fellows. It is in things like this that money is made or saved or economised. A word is due to the C. W. Hunt tramlines, which are so arranged with uniform curves that, by causing the wheels to run on their flanges when passing curves, the curve is taken naturally, the ratio of the new tread diameter being that of the radii of the inner and outer rails. Messrs. Hunt & Co. are the well-known makers of coal conveyor machinery, and some of their work might be seen on the Spree side as well as in London.

We come now to two processes or departments not much in vogue in this country. One of these is the pickling department for castings. Pickling is done for the purpose of removing sand and silicious matter, and is done in all cases except where the form is plain, and the mould can be easily graphited so that the sand drops off without pickling. Castings up to 1 ton in weight are pickled, lathe beds, the columns of milling machines, &c. The process is quite simple as here carried out. The castings are taken direct from the foundry, and little or no pains are taken to remove any sand that adheres. They are simply laid in big troughs of wood, small castings in an indiscriminate pile, large ones in a separate trough. The acid is a mixture of 10 per cent. commercial sulphuric acid, and 90 per cent. water. This is poured over the castings several times daily, and the surplus runs back into its trough, fresh acid being added as the mixture becomes spent, the mixture being used over and over again. The castings are kept moist until the acid gets below the sand and the sand peels off and leaves a clean surface. Twenty-four hours is usually sufficient, but sometimes more time is required. After sufficient exposure, plain water washing removes the acid. The cost is low, the wear of tools is greatly decreased, and the cutting speed of machines is increased. This opens up the whole question of materials and their hardness. In America everything is sacrificed by many manufacturers to speed of production. Castings are pickled, and are often soft in the extreme, and so is the mild steel that is used.

In this German works an endeavour is made to secure proper materials for everything. The supervision of the works is American, and there has been added on to the American system something of German scientific methods. We think that our English engineers have, many of them, been neglectful of the means of securing easy working. How many, for example, carry out the system of pickling their castings? It is not necessary to carry the process to an excessive degree. Properly done, so as just to get below the sand, the sandy silicified surface drops off, and saves both the tool edges which have to cut the iron, and the machines on which the work is done, by the absence of grit.

(To be continued.)

ROCHDALE ELECTRICITY WORKS.

Rochdale, with its 75,000 inhabitants, is the latest of the Lancashire towns to put down a municipal electricity supply works. The plant is at present to be used for lighting supply only, but later on the works will supply energy for operating the tramways.

The Corporation entered into the scheme with the assistance of Mr. E. M. Lacey, M.I.C.E., as consulting engineer, who advised in conjunction with the gas engineer, Mr. T. Banbury Ball.

The system adopted is three-wire, with balancing machine and accumulators, the supply to consumers being at a pressure of 220 or 440 volts, as may be decided by the engineer. A suitable site was found adjacent to the Corporation gas works, situated alongside the river from which water is taken for condensing purposes.

The boilers are of the Lancashire type, 30 feet × 8 feet diameter, constructed for a working pressure of 150 lbs., by the Oldham Boiler Company, Limited. Proctor's automatic stokers, driven by a Lundell motor, have been fitted to these. The boiler fittings are by Messrs. Hopkinson & Co.

The Green's economiser consists of 256 tubes. The scrapers are driven by a Lundell motor, coupled through worm gear to the scraper shaft.

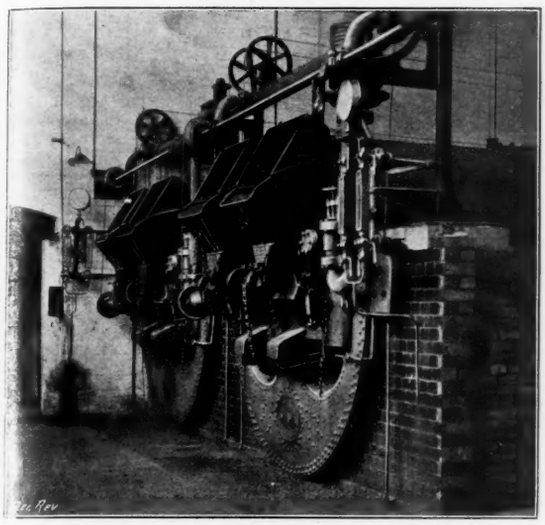
The feed pumps are of the three-throw plunger type, geared to electric motors by means of worm gearing, working in an enclosed oil bath. Each pump is capable of delivering 2,000 gallons of water per hour, against a steam pressure of 150 lbs. per square inch. The motors are of the enclosed type, with two commutators for series-parallel running, and were constructed by Messrs. Wilson Hartnell, of Leeds. The feed pipes are of 3-inch cast-iron, arranged to feed either through the economiser or direct to the boilers. The branch feed pipes to the boilers are in duplicate.

The Works of Ludw. Loewe & Co., Berlin.—Fig. 9.

A cast-iron tank, having a capacity of 3,000 gallons, has been provided for the town water, and a similar tank to hold 2,500 gallons for the hot well. The steam pipes are of lap-welded steel, the branch pipes to the engines being of solid drawn copper. All joints are made with corrugated brass rings. The pipes in all cases are separated by rings sufficiently wide to allow space for ex-

pansion. All steam pipes are lagged throughout with Leroy's lagging, and painted with two coats. The exhaust pipes are of best quality cast-iron. The contractors for the whole of the pipework, pumps, &c., were Messrs. E. Danks & Co.

The electrically-driven surface condenser has been constructed by Messrs. Mirrlees, Watson & Yaryan. It is



Boiler House.

capable of dealing with 12,000 lbs. of steam per hour, and of maintaining a vacuum of at least 25 inches on the exhaust pipes. On test a vacuum of 26 inches was obtained. The air pumps are driven through spur gearing, and the circulating pump is driven direct by electric motors constructed by Messrs. Bruce Peebles & Co. The motors are all of the enclosed type.

The engine room has been provided with a 10-ton travelling crane by Messrs. Carrick & Ritchie.

The generating plant consists of two 3-crank Belliss tandem compound engines, self-lubricating, and arranged to work either condensing or non-condensing. Each of these engines is directly connected to a two-pole Siemens dynamo. These dynamos have each an output of 180-kw., and a series coil has been added in order that the machines may be used as shunt machines for the ordinary electricity supply, or as compound machines for the tramway supply.

The switch gear is of the edgewise type. It was constructed by Messrs. Cowans & Co., Salford, to the designs and specification of the consulting engineers.

The board is built up of strong black marble panels so constructed as to be interchangeable. All switch-gear and connections are on the face of the board, with the exception of voltmeter wires, and all metal work has been so fixed that it may be removed, refixed, or replaced without the necessity of touching the back of the board. The board is provided with four dynamo panels, eight feeder panels, accumulator panels, booster, and balancer panels, three omnibus bars, and 24 vertical bars. The general design of the board is such that the switch-gear and instruments of each dynamo or feeder are in one line of parts. The instruments were constructed by Messrs. James White & Co.

The accumulators consist of 252 cells, capable of giving a discharge of 60 amperes for a period of 10 hours, or 250 amperes for a period of one hour. These cells have been supplied by Messrs. Pritchett & Gold.

The feeder cables are insulated with fibrous material substantially cased in lead and laid in cast-iron pipes. The distributor cables are further protected by two laps of iron sheathing and are laid direct in the ground. The contractors for the whole of the cables were Messrs. W. T. Glover & Co. The feeder and junction boxes are cast-iron pillar boxes erected above ground; by means of these boxes any feeder or distributor can be easily disconnected from the general system.

The contracts were let as follows:—

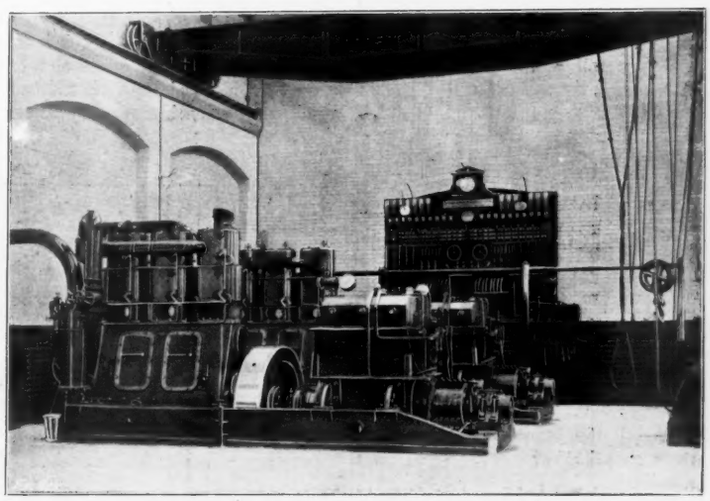
Steam dynamos, balancers, &c.—Messrs. Siemens Bros. & Co.	£4,640	0	0
Boilers—The Oldham Boiler Company	1,160	0	0
Economisers—Messrs. Green & Sons	337	0	0
Condensing plant—Messrs. Mirrlees, Watson and Yaryan	885	0	0
Pumps, feed, steam, and exhaust pipes, tanks, &c.—Messrs. E. Danks & Co.	1,440	0	0
Travelling crane—Messrs. Carrick & Ritchie ...	193	0	0
Switchboard—Messrs. Cowans, Limited ...	848	0	0
Accumulators—Messrs. Pritchett & Gold ...	1,152	0	0
Cables—Messrs. W. T. Glover & Co.	4,978	16	10
Meters—Chamberlain & Hookham, Limited ...	463	15	0
	£16,092	11	10

Some time previous to the completion of the works Mr. C. C. Atchison was appointed clerk of the works, and on the taking over of the works by the Corporation in September last he was appointed borough electrical engineer.

The applications up to the present are for the equivalent of 5,040 8-c.p. lamps, 7 arc lamps, and 4 h.p. in motors. Connected up to the mains are equivalent 1,100 8-c.p. lamps, and 4 arc lamps, and 2½ h.p. in motors. The charge for lighting is 6d., and that for power is 3d. per unit.

In view of the good business with which the works commenced operations a few weeks ago, and also bearing in mind the coming electric tramway supply, it will not be long before extensions to the station plant have to be taken in hand.

To Messrs. Lacey, Clirehugh & Sillar we are indebted for material used in the compilation of this article. For the loan of the negatives from which our illustrations have been produced, we have pleasure in acknowledging our indebtedness to Mr. C. L. E. Stewart, the assistant engineer.

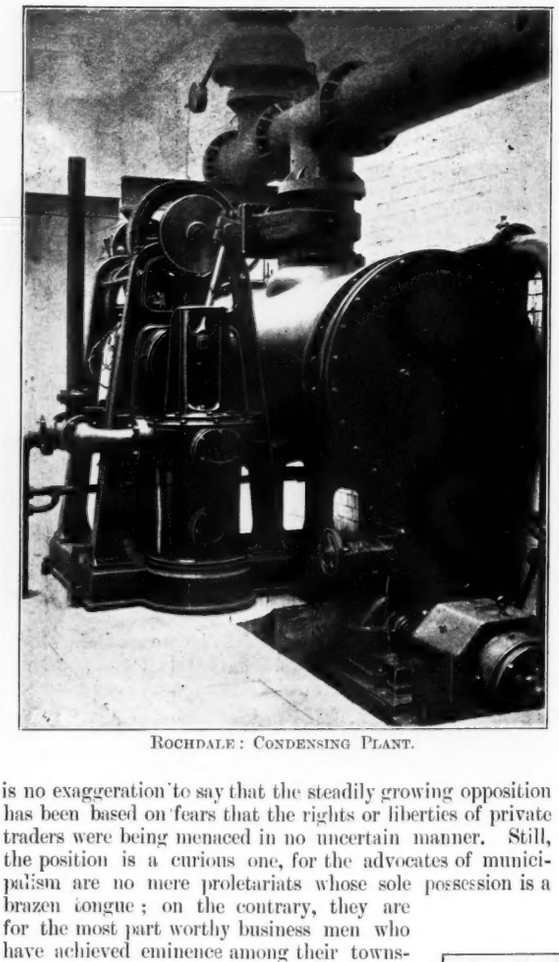


General View of Engine Room.

THE LIMITATIONS OF MUNICIPAL ENTERPRISE

It is not unlikely that during the next two or three months we may have an official pronouncement on municipal trading, but whether the recommendations of the Parliamentary Committee, which has so diligently collected evidence, will be followed by definite action, is quite another matter. The influence of municipalism is strong in the land, and is not without its effect even at St. Stephen's. Notwithstanding the strong position occupied by the great municipalities, however, we doubt whether it is of sufficient moment to vitiate legislative action. Without the advent of electric lighting and tramways, it is probable we should have heard little of municipal trading for at least some years to come, because it is mainly in carrying out work in these directions

that the question of municipal *versus* private trading has been raised in such an acute form. It is not by reason of incapacity, nor by lack of honesty and integrity in the conduct of municipal undertakings, that Parliament has been asked to limit the sphere of municipal activity; it



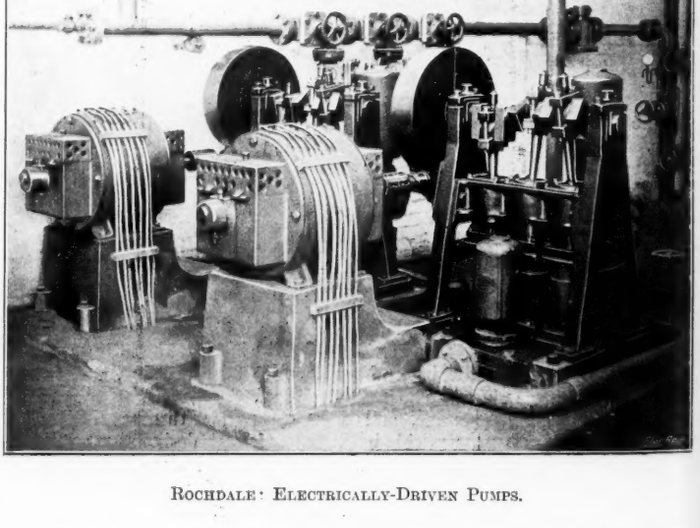
Rochdale: Condensing Plant.

is no exaggeration to say that the steadily growing opposition has been based on fears that the rights or liberties of private traders were being menaced in no uncertain manner. Still, the position is a curious one, for the advocates of municipalism are no mere proletariats whose sole possession is a brazen tongue; on the contrary, they are for the most part worthy business men who have achieved eminence among their townsmen, not because they have been possessed of revolutionary ideas, but rather from the fact that they were men of substance and had a serious interest in property and in the well-ordered arrangements of society. Whether or not electric lighting was a duty which properly belonged to a municipality, it is, perhaps, unnecessary to discuss, but there can be no question that the majority of electrical undertakings which are owned and controlled by local authorities have been, as far as economical management is concerned, amply justified; moreover, it is to be remembered, to the credit of such concerns, that the cost of electricity has been materially reduced, and in many towns the adoption of special hiring arrangements and sliding scales has done much to popularise electric lighting among the poorer classes. Private enterprise could not have done more, and we doubt whether it would have done as much. After achieving conspicuous success in the generation and distribution of electricity, it was not surprising that municipalities should have become possessed of the desire to apply electricity to the operation of local tramways; though in some cases there was much to be said in favour of such a course, the undertaking would in the natural course of expansion necessitate a municipality going outside its area, and immediately difficulties arose which were of such a nature as to suggest that the local limitations of a municipality were distinctly defined.

The precise bounds of municipal enterprise, however, are by no means easy to describe, and though many financial and legal luminaries have discussed the subject, it cannot be said that discussion has brought us much nearer to a solution. Mr. Emile Garcke, whose work has brought him in close contact with municipalities—though in such a way as to suggest that he can have little sympathy with local authorities—has been recently discoursing before the Political and Economic Circle of the National Liberal Club on the "Limitations of Municipal Enterprise," and, apart from the lecturer's position as the head of an organisation whose development ought to be of the greatest concern to the industries of many large towns, the remarks made formed a useful contribution to the subject. A municipal indebtedness of £262,000,000 is enormous, but it would be rash to immediately presume that these staggering figures are indicative of reckless expenditure. On the contrary, the sum of £87,000,000 which Mr. Garcke says represents the amount employed for trading and similar purposes, showed an income, after payment of all charges, of about ½ per cent. Such an income would not be gratifying to a private undertaking, but probably the ardent municipalist would argue that in the case of municipal enterprise it ought to be no more.

One is inclined to agree with the author of the paper that municipal enterprise has proceeded without any definite ideal, but it may have been none the worse for that. It may be said equally that the proceedings of legislators have been conducted for the past 100 years without any ideal, but there can be no comparison between the laws of to-day and those of a century ago. It was obviously difficult to apply hitherto any method of regulation to the development of municipal undertakings, because it is only during the past few years that there has been much activity in purely trading ventures.

In discussing the trend of municipal enterprise one need have no regard to so-called Socialistic theories, it is a matter that requires a little plain common sense, and does not necessitate the use of any vague terms whatever. It is commonly accepted that there are certain duties affecting the whole of a community which are undoubtedly best carried out by a central authority, and where no profit attaches to such services it is clear that the acting authority should be one elected by the ratepayers. But though there may be unanimity as to the functions of an elected body in regard to sanitation, water supply, and similar services, the neglect of which might endanger the health of a community, there are many who do not believe in extending the work of municipalities beyond these, and it must be admitted that directly we go beyond such undertakings, it becomes increasingly difficult to draw the line. Mr. Garcke goes so far as to admit that the principle of the municipalisation of



Rochdale: Electrically-Driven Pumps.

distributor cables are further protected by two laps of iron

because it is mainly in carrying out work in these directions

industrial undertakings was one that should be encouraged, provided it was with a view to the rendering of public services, and not purely for the purpose of making profits with a view to the reduction of the local rates. This view coincides with that of many leading municipalists, and, if we remember rightly, shows that the attitude of Mr. Garcke has undergone a somewhat notable change. But while admitting the claims of the municipality to undertake certain trading functions, the author clearly defines the difference between a local authority and a private company undertaking such work: "Private enterprise must, in most cases, necessarily make profits its first aim, but municipalities could also make efficiency and refinement their objective. There was no economic or moral advantage in transferring the conduct of industrial undertakings to the authorities if such undertakings were to be carried on in the same manner and with the same aims as characterised industrial enterprise when in the hands of individuals." Municipalities have not often, however, taken so high a view of their undertakings, and we are afraid the commercial aspect has been a little too prominent. We entirely agree with the view that many municipalists have ignored the moral advantages which should follow upon wider municipal activities, and some have utterly neglected their obligations to extend their various services in order to bring them into general use. In spite of the success which municipal electrical undertakings have met, there is not sufficient readiness exhibited in extending the mains, and the reason usually advanced is that it would not pay to do so; this is certainly not the high standard of trading which Mr. Garcke seeks in a municipality.

In tramway, as well as in telephone, operations there will always be territorial limits imposed on municipalities, and it is such limits which seriously militate against the usefulness of a tramway undertaking; these limits will be created merely by the jealousies between local authorities. There will, probably, always be a difficulty in municipalities initiating new undertakings, and as the author points out, it would be a serious thing for the commercial prosperity of the country if, as a result of municipalisation, private enterprise was discouraged to such an extent that the introduction of new industries was left to the initiative of local authorities. Such a danger is not likely to arise until local authorities are permitted to engage in manufactures, and from that we trust we are far removed.

There is not much reason to doubt that unrestricted municipal trading is likely to result in over-trading; but we think the chief danger which confronts all municipalities is the tendency to dabble in too many things. The early success which was achieved in electric lighting made local authorities ambitious to embark on other electrical ventures, and the result has been in many cases that electric lighting has not been developed in a proper manner. It is by no means difficult to give instances of electricity works which have not grown as one would have expected; in fact, we will go further, and say that municipalities have not done as much as they ought to have done for electric lighting. The critics of municipal trading, however, do not, as a rule, seek to limit the scope of a local authority in developing a system which it already possesses, but it is clear that some line of demarcation should be drawn between what a municipality should undertake and what it should not. At the same time, as Mr. Garcke points out, it is difficult to classify the industries which it is undesirable for municipalities to undertake. Still, there ought to be no difficulty in defining the chief duties of a municipality; it might be permitted almost without let or hindrance to supply such commodities as water, gas and electric light, but we should strongly deprecate municipalities engaging in indiscriminate manufacture. Although the author of the paper under review hardly goes so far as to define the precise limits of municipal trading, he suggests that the principle of charging for services rendered by a Corporation should be based on no surplus, or should there be a surplus, it should be applied to reduction of the charge for such services or to an increase of sinking fund for reduction of the capital account, but in no case should such surplus be applied to a reduction of rates. We think the average man would be inclined to agree with the author in the following remarks which concluded the paper:—

"If the ratepayers were frankly told that the enterprises they were asked to sanction were not for the primary purpose of reducing the rates, it would be found that the really dangerous aspect of municipalisation would disappear, while such undertakings as were allowed by the ratepayers to be municipalised would be carried on at the risk of the community for the benefit of the community—not in the narrow sense of producing commercial results, but in order to render public services which were of such general importance to the community that their excellence and efficiency were paramount considerations. The first object of municipal government should be not to engage in the pursuit of wealth, but to elevate the moral and material surroundings of the people."

ELECTRIC TRACTION NOTES.

(*Continued from page* 704.)

Wolverhampton.—The Tramways Committee issued, on Tuesday, a lengthy report respecting the electrical equipment of the tramways, from which we extract the following:—

Owing to the high price of materials, your Committee have delayed taking steps towards the construction of the new tramways, but as there now appears a tendency for prices to be lowered, they feel justified in recommending the Council to proceed with the laying down of certain lines. The first line of route to be constructed should be that from the Upper Green, Tettenhall, along New Hampton Road, Waterloo Road, Darlington Street, Queen Square, Lichfield Street, Piper's Row, Bilston Street, and Bilston Road to the borough boundary. When this route is complete and in working order, it will afford facilities for reaching Tettenhall *via* New Hampton Road, whilst the Tettenhall Road line is being converted to electric traction. The overhead system will be the best to meet the requirements of Wolverhampton. One advantage is, that it lends itself readily to the combination of street lighting and electric traction, since the posts carrying the overhead wires may be used to support arc lamps without appreciable extra expense. Its further advantages are moderate cost of construction, cheapness of traction, simplicity of working, the ease with which repairs can be effected, &c.

The Committee recommend that the whole of the tramway route now under consideration be paved with granite setts, with the exception of that portion opposite Higher Grade Schools, and Lichfield Street, to be paved with wood, and steeper gradients than 1 in 20, to be paved with sandstone setts. Negotiations with the Markets Committee have transpired with the object of acquiring portion of the cattle market, to use the same for the erection of suitable buildings thereon for use as a central car depôt, repairing shop, &c., in connection with the electric tramways. The site in question is very central, and it is anticipated will be found very convenient. For the revision of the specifications to be prepared by the borough surveyor and borough electrical engineer, your Committee have engaged the services of Mr. Alfred Dickinson, C.E., of the firm of Messrs. Alfred Dickinson & Co., of Birmingham, who have had a very wide and varied experience. With respect to the electrical energy required to work the new tramway system, your Committee are of opinion that the Lighting Committee, who have control of the Corporation electric light undertaking, should be requested to extend their works, so as to supply all electric energy that may be required for tramway traction purposes.

The report concludes with a number of recommendations to the Council for carrying the Committee's suggestions into effect at an early date.

Rhondda.—An inquiry has been held at Cardiff into the proposal to construct an electric tramway from Havod, which lies at the entrance to the Rhondda Valley, some miles up towards the centre. The scheme is a portion of a larger one. A mass of evidence was given, the primary element of objection being that railway construction on the line proposed might be perilous. The Rhondda District Council is prepared to spend £14,000 in widening the road, whilst the promoters of the present scheme were only prepared to spend £3,300. The Council would not oppose if the promoters were prepared to agree to the expenditure of the former sum. The Commissioners reserved their decision upon the matter.

St. Helens.—The Electric Supply Committee has instructed the town clerk (Mr. G. W. Bailey) to take the necessary steps for the construction of a loop line in connection with the tramway from Robin's Lane to the borough boundary in Bold Road.

Staines and Egham.—The scheme for some 30 miles of light railways in the Staines and Egham district has been abandoned by the Staines and Egham Light Railway Company, the company and the Middlesex City Council, who were jointly interested in the scheme, having failed to agree upon essential particulars. The company, however, will promote the construction of a mile of railway at Staines, being part of the original scheme, but their application for powers will be opposed by the City Council, the Tramway Committee of which foreshadows an extensive coming scheme.

Swansea.—A Light Railway inquiry was held at the Town Hall, Swansea, on Wednesday last week, regarding the application of the Corporation for powers, under the Light Railways Acts, to carry out certain tramway works, chiefly inside, but partly outside, the borough. They included nine new sections of tramways, including a new tramway through the town, and extensions to the suburbs of Sketty, Port Tennant, Forestfach, and Midland Terrace, Morriston, the other four being minor sections, allowing for connections between the services, &c. Mr. J. E. Waller (engineer to the Corporation) gave evidence as to certain questionable portions

of the scheme, and said they presented no engineering difficulties. The Commissioners intimated that speeches would have to be heard in London, as the Court could not sit in Swansea on Thursday. The inquiry was adjourned, therefore, to London.

TELEGRAPH AND TELEPHONE NOTES.

China Cables.—The *Standard* Berlin correspondent says that the German and Japanese Governments have concluded their negotiations for the laying of a submarine cable between Tsing-tau and Nagasaki, a distance of about 715 kilometres. The work will be commenced as soon as the cable is ready. The Nagasaki line will be prolonged later on to the South Sea Islands; while the Shanghai line will be extended *vid* Fuchow, Amoy, and Swatow as far as Canton. The Pekin-Taku-Chi-fu telegraph is now worked partly by wire and partly on the Marconi system.

Dublin Telephones.—The National Telephone Company sent a deputation to the County Dublin County Council last week to ask for certain concessions in connection with the proposed extension and improvement of their system in rural districts. They sought permission to erect 153 poles, and the Council decided to charge 1s. per pole.

Melbourne and Sydney Telephones.—The *Sydney Daily Telegraph* says that early in September Mr. Watt forwarded to Mr. Crick a report on the cost of connecting Melbourne and Sydney by telephone. The length of line would be 576½ miles. The existing quadruplex poles could be used on the Victorian side, but on the New South Wales side new poles are said to be necessary. The cost of line to Albury, the Victorian contribution, is given as £12,016, and the cost to New South Wales for the line between Albury and Sydney is given as £33,110, including 204 tons of wire £20,400, and the poles £12,170. Therefore, the total cost of the line is estimated at £45,126. If continuously used at a fee of 3s. for five minutes' conversation, the return would be £6,765, or 15 per cent. on the total cost. Mr. Watt will be largely guided by Mr. Crick's answer.

The Pacific Cable.—Reuter's Sydney agent says that the Bill enabling New South Wales to join the other colonies and Great Britain in the construction and maintenance of the Pacific cable, has now passed all stages without opposition.

The *Sydney Daily Telegraph* of September 12th published the following from its London correspondent:—"No tender has yet been accepted for the construction of the Pacific cable. A difficulty has arisen respecting the appointment of a member of the Cable Committee in place of Sir Julian Salomons, the ex-Agent-General for New South Wales. The New South Wales Government nominated Mr. Henry Copeland, its present Agent-General; but Queensland desires to nominate a representative, suggesting either Sir Henry Norman, ex-Governor of Queensland, or Sir Horace Tozer, the present Agent-General for that colony. The official estimate of the cost of the cable, including two maintenance steamers and all other initial expenditure, was £1,730,659. The actual lowest tender (that of the Telegraph Construction and Maintenance Company) was £1,886,000. The tenderers undertook to manufacture and lay the cable, provide and erect cable houses, make the surveys necessary, and keep the cable working for 30 consecutive days for that sum. It is understood that the other expenses will amount to £180,000, and will include the cost of erecting station buildings and staff quarters, of instruments and engineers' fees, and the price of one maintenance ship, to cost £80,000. These are not included in the tender submitted by the Telegraph Construction and Maintenance Company. The total preliminary cost of the cable would be, therefore, under the tender in hand, £2,066,000."

Portsmouth Telephones.—The T.C. have adopted a report from the Finance Committee stating that as the Postmaster-General has intimated his readiness to grant a license to the Corporation, they recommended that the smaller scheme mentioned in the report of Mr. A. R. Bennett, be adopted. In order to make the necessary arrangements for establishing the exchange, the Committee recommend that Mr. Bennett be appointed consulting engineer at a fee of 5 per cent. on the outlay, which is to include engineering, designing and superintendence during construction, the starting of the office, and advising on the necessary books, forms, and details of management, and also starting the manager in his duties. The Committee also asked for authority to appoint a manager and canvassers, so that, although a sufficient number of promises to use the exchange have already been obtained, further additions may be made to enlarge the list, and thus promote its efficiency and general usefulness.

West Hartlepool Telephones.—Messrs. Bennett and Ward-Thomas, of Manchester, have been instructed to report on a municipal telephone exchange for West Hartlepool.

Wireless Telegraphy.—It is stated that with the object of increasing the efficiency of the arrangements for defending the entrances to the rivers Thames and Medway, wireless telegraphy apparatus has been fitted at Sheerness and Shoeburyness garrisons for the transmission of messages across the estuary.

The results of the use of wireless telegraphy on the Dover-Ostend mail boats, the first line to adopt the system, are referred to in the daily press. It is stated that on 28th ult. the apparatus for installing the system on the steamer *Clementine* was taken across from Dover to Ostend, where the vessel will be fitted up. The land station in Belgium to be used in connection with mail boats is already established at La Panne, which is just on the French frontier, and is the point from which the submarine cable runs across the Channel to St. Margaret's, near Dover. It is the nearest point of the Belgian coast to England. The mast at the Marconi station at La Panne is 130 feet high. On the foremast of the mail steamer *Clementine* will be affixed another mast carrying it some 60 feet higher. A special room has been set apart for the instruments on board, and from this the cable will be carried to the top of the extended mast. It is believed that communication between ship and shore may be obtained for quite 30 miles, or half-way across. By the establishment of a station at Dover those on board the vessel would be able to keep in touch with the land throughout the journey.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
South American:—		
Pará-Maranham	March 1, 1900	
Ceará-Maranham	Feb. 20, 1900	
Paramaribo-Cayenne	Oct. 6, 1900	
West Indian:—		
Mole St. Nicholas-Cape Haitien	March 6, 1900	
African:—		
St. Louis (Senegal)-Bathurst	Aug. 25, 1900	
Zanzibar-Mombassa	Sept. 29, 1900	
Latakia-Cyprus	June 20, 1899	
St. Jacques-Thuanan Hué	Oct. 23, 1900	Oct. 23, 1900.
Landlines:—		
Chinese:—		
Tientsin-Pekin	June 12, 1900	
Pekin-Kalgan	June 14, 1900	
Kalgan-Maimatchin	June 30, 1900	
Tientsin, *via* Shanghai	June 16, 1900	
Tientsin-Niuchwang	June 18, 1900	
South American:—		
Communications with all offices of Colombia beyond Buenaventura	January 22, 1900	
Ecuador landlines	March 18, 1897	
Landlines south of Serena	July 30, 1900	
Higuerote-Barcelona Venezuela	Oct. 30, 1900	
Communication "*via* Hanekine" interrupted on Persian territory	Feb. 24, 1900	
All lines connecting Cochin China with Thuanan	Oct. 23, 1900	
Communications between Saigon and North Annam and Tonkin	Oct. 23, 1900	

CONTRACTS OPEN AND CLOSED.

OPEN.

Belfast.—November 23rd. Tenders are invited for steam pipes, pumps, condensing plant, boilers, mechanical stokers, superheaters, coal and ash conveying plant, and switchboard extensions for the Corporation electricity works. See "Official Notices" October 12th.

Farnworth.—November 12th. The U.D.C. wants tenders for "free wiring." See "Official Notices" to-day.

Glasgow.—The Glasgow International Exhibition (1901) Executive Council invites tenders for the erection of the wiring for arc and incandescent lighting, and electric motors. The main cables, arc lamp cables, arc lamps, incandescent lamps, &c., will be supplied to the contractor, who must take delivery thereof and erect same. Particulars on application to Mr. Thomas Young, the engineer, 4, West Regent Street, Glasgow.

Grantown-on-Spey.—November 6th. The Commissioners invite tenders from electric light companies to supply electric light for public and private consumption within the burgh, stating highest price charged consumer, and terms for future purchase by burgh.—W. Forsyth, Town Clerk.

Greenwich.—November 22nd. The Guardians want tenders for the electric lighting of the new workhouse now erecting. See "Official Notices" to-day.

Halifax.—The Tramways and Electricity Committee wants tenders for various sized underground cables. See "Official Notices" to-day.

Harwich.—November 17th. Tenders are being invited for gas engines, dynamos, cables, battery, lighting and traction switchboard, track laying, and traction equipment, &c. See "Official Notices" to-day.

Ilford.—November 12th. The U.D.C. invites tenders for free wiring. See "Official Notices" October 26th.

Kendal.—November 25th. The Corporation wants tenders for complete electric lighting station equipment (boilers, steam dynamos, battery, &c.); and for underground mains, meters and services. See "Official Notices" to-day.

Lincoln.—November 15th. The Corporation wants tenders for a dryback marine-type boiler; a high speed engine coupled to a C.C. dynamo; pump and motor and accessories.

London.—November 10th. The Streets Committee of the Corporation wants to hire a mechanically driven dust cart. See "Official Notices" October 5th.

London.—November 13th. The L.C.C. wants tenders for about 150 arc lamps (80 10—12 amperes and 70 5—6 amperes) for the lighting of the Victoria Embankment and Westminster Bridge. See "Official Notices" October 26th.

Lowestoft.—November 2nd. The Corporation wants tenders for two water-tube boilers, economiser, pipework, and one 250-KW. steam dynamo. See "Official Notices" October 19th.

Lowestoft.—November 2nd. The Corporation wants tenders for wiring the Town Hall. See "Official Notices" October 19th.

Manchester.—November 9th. The Tramways Committee wants tenders for the supply of cast-iron bases for tramway poles. See "Official Notices" to-day.

Pemberton.—November 8th. The Council wants tenders for boilers, engines and dynamos, battery, switchboard, crane, and conductors, for electric lighting. See "Official Notices" October 19th.

Stavanger.—January 2nd. Tenders are invited by the Stavanger Corporation for the establishment of electrical communication or transmission of power from the Altesrig Waterfalls to Stavanger, a distance of about 39 kilometres, in accordance with the plans of a civil engineer named Schoien. Tenders must be received by January 2nd, 1901. Further information may be obtained on application direct to Mr. E. Berentsen, British Vice-Consul, Stavanger.

Stockport.—November 24th. The Tramways Committee wants tenders for the construction of permanent way, excluding bonding and paving, for about 2¼ miles of double and 2¼ miles of single track. Mr. J. Atkinson is the borough surveyor.

Walker.—November 12th. The U.D.C. wants tenders for the erection of a 2-unit Meldrum destructor, including boilers, steam pipes, &c. See "Official Notices" October 26th.

CLOSED.

Aberdeen.—The Aberdeen *Free Press* says that the Gas and Electric Lighting Committee last week opened tenders "for two 2-cwt. KW. generating sets and balancing sets," and the offer of Messrs. Mavor & Coulson, of £5,144, was accepted. Presumably two 200-KW. sets is what is meant!

Cardiff.—The Tramways Committee has accepted the tender of Messrs. Dick, Kerr & Co. for tram rails. Mr. John Jenkins thought the rails should have been made in England and not in Prussia. Last Friday the Committee considered the tenders for various parts of the equipment of the electrical station, taking them in three sections. For engines there were 22 tenders, ranging in price from £10,300 to £20,900. That of Messrs. Musgrave & Co. for £14,508 was accepted. For generators there were 26 tenders, ranging from £6,300 to £12,400, and that of Messrs. Westinghouse for £7,464 10s. was chosen. The tenders of Messrs. Danks & Co. were accepted for boilers at £2,767, economisers £530, superheaters £450, water tank £495, and pumps £371. Messrs. Vicars' tenders for a "Vicars stoker" at £684, conveyor £159 10s., elevator £131, and bunkers £917, were also accepted.—It was decided to advertise for a motor-generator and cables. Doulton's conduits will be ordered as required to be laid by the public works department at the cost of the Tramways Committee.

Redditch.—The U.D.C. has affixed the seal to a loan of £8,000 for work connected with the electric light, and also to the contract with Messrs. Willans & Robinson for the new generating plant at the electric light station.

Southampton.—The Harbour Board has considered the tenders for the electric travelling crane, and that of the Clayton Engineering and Electrical, &c., Company, Limited, of Newton, Hyde, at £735, was recommended for acceptance, provided they agree to substitute Siemens Bros. & Co.'s electrical work in the crane.

FORTHCOMING EVENTS.

Tuesday, November 6th.—At 8 p.m. Institution of Civil Engineers. Ordinary Meeting; address by J. Mansergh.

Thursday, November 8th.—At 8 p.m. Institution of Electrical Engineers. Opening meeting for the new session, when Prof. John Perry will deliver his inaugural address. Presentation of premiums.

Wednesday, November 14th.—At 8 p.m. Institution of Electrical Engineers (Glasgow Local Section). Meeting at Institution of Engineers and Shipbuilders, 207, Bath Street, Glasgow; paper on "Electrical Supply" by W. A. Chamen.

NOTES.

Naval Notes.—The practice of placing the searchlights of torpedo boats and torpedo boat destroyers on the fore-bridge instead of amidships, as has been the custom of private building firms, is a decidedly better arrangement than that adopted by the Admiralty. When a searchlight is required to be used at all, it is wanted over a large arc of the horizon, and where it is most required—right ahead—the midship light is of very little use. To succeed in picking one's way through a narrow passage at night time, and with a searchlight that necessitates a very free use of the helm before it will bear, is by no means easy. The midship light has got many obstacles in its path; first there is the whole of the forecastle, which obscures at least 30° on either bow; then there is a whaler hoisted at the davits, almost abreast on one side, and getting very much in the way; right astern are the funnels; the consequence is that the light becomes of very little practical use at all. Far different is it, however, with the forebridge light; it is only obscured astern by the tops of the funnels, and there appears to be no appreciable objection attached to its position from any other point of view.

The Navy has not yet adopted the "bayonet joint" generally in the ship's installation of electric light. Under the present conditions, using bottom loops and spring holders, there are always a number of lamps "put out of action" after firing heavy guns, and even if the precaution of shipping them is taken, the platinum loops generally suffer in the operation; the waste of lamps would therefore seem to be capable of reduction by the use of a more substantial type of fastening.

In some waters of the West Coast of Africa very considerable corrosion takes place. What the actual cause is we do not know, but it seems highly probable that it is due to the products of rotting vegetation carried down by the rivers. The action is galvanic, and takes place to a marked degree when two dissimilar metals are immersed in metallic connection with one another, at the expense, of course, of the positive electrode. Fishermen are very keenly alive to the fact, for without due precaution their tackle suffers very materially from local action. It is common to soak such parts of it as brass swivels, eyes, &c., in melted beeswax in order to protect them, and we recently heard of a man who habitually attached a small piece of zinc to his spreader; this saved him the trouble of coating his gear continually with beeswax, and, according to all accounts, was a decided success. Talking of corrosive action in sea water, it is curious to notice the effect upon under-water fittings when a ship is in dock. In spite of the zinc plates that are attached in the vicinity of the screw, one finds evidence of very severe pitting, and upon close examination it will be found that the surface metal is quite spongy, the zinc having been eaten out of the brass in which it was originally incorporated. We know of no better illustration of the effect than the appearance of a piece of impure silver that has been used as the anode in a plating bath.

Mechanical Stoking in America.—It is not a little remarkable that the progress of mechanical stoking in America has been very rapid of late—far more so than it has been here. Indeed, very little progress has been made on this side. The reasons are obvious. The internally-fired boiler is not suited for mechanical stoking. To fit moving grates and the general paraphernalia of the mechanical stoker to an internally-fired boiler is a work of some difficulty. The travelling grate alone demands a good deal of mechanism. Further, a good-looking well made boiler is completely disfigured by the application of the machine, and this alone is a sufficient reason for many people to refuse to apply it. The water-tube boiler, on the other hand, is too hopelessly ugly to be made worse by a machine stoker, and it possesses the advantage that there is ample room below it for the application of stokers of suitable design. The Metropolitan Street Railway Company, of New York, are equipping boilers of no less than 66,000 H.P. with machine stokers, while one firm alone, who are doing this for them, have orders for about a quarter of a million horse-power of stoking equipment. The

boiler of America, when not a water-tube boiler, is usually a plain underfired cylinder, and this is even more suitable than the water-tube type for mechanical stoking. With good water an externally fired boiler is fairly safe, but it has been tabooed in this country by the Insurance Companies, probably because few pure feed waters can be found. There are, however, certain feed waters that could be used safely in these boilers, which possess the important advantage of not being easily or rapidly put into the predicament of being short of water. We have previously pointed out that the chief difficulty with mechanical stoking is that of feeding the fuel forward on the grate with sufficient speed to fill the back of the grate with enough fuel to prevent excess of air from passing through the bars. The type of stoker that has grown so much in America is that in which the grate is very steeply inclined, and the force of gravity is brought in to assist the movement of the bars in covering them with fuel to their extreme end. Without this aid the best type of stoker—namely, that known as the coking type, to distinguish it from the sprinkler type—cannot hope to be a really economical machine, because its fires burn so bare at the back end, that a huge excess of air is admitted: attempts have been made to meet this fault by means of a solid plate applied under the back part of the bars, and placed so close up to them as to check the flow of air, which in the inclined grate is better checked by the accumulation of fuel, brought about by the combined action of gravity and grate movement. No very serious growth of mechanical stoking seems probable except with externally fired boilers. The American mechanical stokers are but improvements on old designs, and as regards the grates of many of them, they practically represent the old Tenbrink form of grate, so much used at one time, if not still, on the Continent. The *Scientific American* is at present publishing descriptions of some of the representative forms of stokers. We feel fairly confident that only with externally fired boilers will success be real and permanent.

The Proceedings of the Municipal Electrical Association.—There have just been issued the *Proceedings* of this Association for the years 1899 and 1900. The price of each volume is 3s. 6d., and copies are obtainable from Mr. A. B. Mountain, Corporation electrical engineer, Huddersfield. The various papers and discussions which formed part of the proceedings at the Bristol Convention are given in the 1899 volume, the 1900 volume containing the discussions and papers which took place at Huddersfield in June last. Each contains the presidential address for the year and various business reports.

Personal.—On Friday evening, October 26th, the staff and employés met at the Huddersfield electricity works to present to Mr. J. R. P. Lunn, the mains superintendent, who is leaving to take the position of borough electrical engineer at Darlington, a timepiece and ornamental figures which had been subscribed for by the staff and employés.

At a special meeting of Partick Commissioners last week, Mr. Maxwell, of Worcester, was unanimously appointed resident electrical engineer for the burgh.

Mr. Thomas Tomlinson has been appointed borough electrical engineer at Bray.

Appointments Vacant.—A junior station assistant is required for the Aberdeen electricity department. The Farnworth U.D.C. wants an electrical engineer at £200 per annum. The Ashton-under-Lyne Corporation requires an electrical engineer at £350 per annum. The Glasgow Corporation wants an assistant telephone engineer. An assistant engineer at £104 per annum is wanted for Crewe electricity works. A shift engineer at £90 per annum is wanted for the Southampton electricity works. The Wrexham T.C. wants a borough electrical engineer. The Wolverhampton Lighting Committee require a chief clerk and canvasser for the electricity department at £100 a year and commission. See "Official Notices."

The "Underground."—It is stated that the tenders for the electrical working of the Metropolitan Railway have to be submitted by December 1st.

Enclosed Arc Lamps on Series Circuits.—The current issue of the *American Electrician* contains some editorial comments on this subject. The writer says that the contention has frequently been made—just on what grounds was never made clear—that the benefit of enclosing the arc of a direct current lamp was out of the reach of the poor unfortunate mortals who operate series circuits from arc dynamos. There was some mysterious reason why direct-current enclosed arcs on series circuits were impracticable, although hundreds of alternating-current arcs are working in that manner every night. Of course such an argument cannot be sustained by any sound engineering considerations, and probably no one has deemed a logical controversion worth the trouble when confronted with this wholly arbitrary statement. That none is necessary is fully demonstrated by the operation of the municipal plant at Grand Rapids. The tests of this plant show the interesting economy of $1\frac{1}{3}$ lamps per horse-power indicated in the engine cylinders—not delivered to the dynamo pulley. This is not as good as a modern constant potential generator would show, driven by the same engine, but it is sufficiently high to justify a careful comparison of the two systems in laying out an arc-lighting plant. On the one hand, the direct-current apparatus is simple in the extreme, has a power factor of unity, and is cheaper to instal; on the other the constant-potential system is more efficient, more economical in floor space—one generator type serving all needs—and more flexible. But it has a low power factor and necessitates either a multiplicity of circuits or the use of cumbersome station transformers. In the latter case the efficiency falls nearly to a level with that of the direct-current enclosed arc system.

Government Observatories and Electrical Traction.—Sir Courtenay Boyle presided at the Board of Trade on Wednesday afternoon over a private conference arising from a desire on the part of the scientific departments of the State that the delicate instruments in use at Kew and Greenwich Observatories should, by regulation, be protected from magnetic disturbance through the working of tramways and railways in the metropolis by electricity. According to the *Times*, among the officials of the Board of Trade present were Mr. F. J. S. Hopwood, Sir Thomas Blomfield, and Mr. Trotter. The observatories and kindred public departments were represented by Mr. Christie (the Astronomer-Royal), Prof. Rücker, Mr. Glazebrook (Director of the National Physical Laboratory), Lieutenant-Colonel Raban (Director of Works at the Admiralty), Admiral Sir W. J. Wharton (Hydrographer to the Admiralty), and Profs. Ayrton and Perry. Among those who attended as representatives of the railway and tramway interests concerned were Mr. George White, chairman, and Mr. J. Clifton Robinson, engineer, of the London United Tramways Company, Sir Benjamin Baker, and Sir W. H. Preece.

Electrical Engineers R.E. Vols.—The following are extracts from a letter received by Major Crompton from Captain Lloyd, R.E. on October 29th:—

Captain Lloyd has been appointed D.A.A.G. for transport in addition to his duties as O.C.E.E.R.E.

Sergeant Phillips, Corporal Hossack, Q.M.S. Wordmore, R.G.A., with three civilian engine drivers, have gone to Koomati Poort to bring up rolling stock.

Captain Leaf, with his detachment, including Sergeant Graham, Corporal Sellon, Lance-Corporals Peart and Leven, also to Koomati Poort with No. 2 engine and lighting gear to enable night work to be carried on, and bring up captured rolling stock.

Company Sergeant-Major Rorke returned from front to Pretoria, and sent to Waterval to bring in captured engines, boilers and dynamos.

Corporal Sellon, discharged from hospital, and now at work in Pretoria.

Apart from special duty above-shown, Sergeant Phillips, Corporals Hossack and Hodgson, and Sapper Young are regularly on traction work, in addition to eight drivers belonging to steam transport (civilians).

Captain Lloyd reports that the E.E.R.E.V. will probably leave South Africa by November 4th.

Manchester Electricity Committee.—Last Saturday one of the city auditors, Mr. S. N. Williams, published in the *Manchester City News* an address bearing on the conduct of the Electricity Department, in which, clothed in somewhat extravagant and self-righteous language, a number of allegations are made against the Electricity Committee, the city electrical engineer, and the Lord Mayor-elect, Mr. Alderman Higginbottom, who is the chairman of the Committee. In brief, the charges against the Committee are as follows:—That it is a great money spender, and has been badly managed; that it sells electricity under cost price. Against the engineer:—That contracts have been placed without competition, to the number of 70, amounting to over £9,500 in value; that salaries have been raised and appointments made without the knowledge of the Committee; that discounts have been lost by delay in settling accounts; that extras have been incurred on contracts. Against Mr. Higginbottom:—That he is connected with certain companies doing business with the Corporation: that Messrs. Higginbottom & Mannock supplied and erected cranes for the Corporation through another firm.

The charges brought against the engineer, Mr. Wordingham, were all dealt with in a report on the administration of the electricity department, which was drawn up by a special subcommittee some weeks ago; the conclusion arrived at being "that during the past few years there has been a laxity in bringing many matters of importance to the notice of the committee, which is not in keeping with the general practice obtaining in other departments"; and the discontinuance of the present system of ordering goods under "quotation" was recommended.

The allegations against Mr. Higginbottom were more serious, and led to a lengthy reply on his part in the Council on Wednesday last. Mr. Williams's charges as to favouritism were fully answered, and his statement as to the sale of electricity under cost price, to encourage the use of motors, was shown to be based on utterly fallacious ideas on his part as to the effect of long and short-hour consumption. Mr. Higginbottom also stated that the cranes made by his firm were sold to other firms, who fitted them up with electric motors, and in turn sold them to the Committee. After a protracted discussion, a special committee was appointed to investigate the matter and report to the City Council on Monday morning next.

Charging Electrical Vehicles.—We read in the *Motor-car Journal* that Mr. Percy Still, chief engineer of the Chelsea Electricity Supply Company, Limited, has written to the Automobile Club stating that his company are considering the question of providing facilities in Chelsea for storing and charging the batteries of electric motor cars. He states that they could make such arrangements if there were a probability that advantage would be taken of them to a reasonable extent. Before deciding upon the terms on which they could provide suitable space and electric current for this purpose, the company would like to have some information as to the amount of current and the pressure which is usually required, the average time occupied in charging, between what hours of the day attendance should be provided at the charging depôt for admitting motor cars and looking after the arrangements.

Telephonic Shortcomings.—The National Telephone Company may have a host of troubles, but we find it hard to be sympathetic. When Post Office competition in the London area was feared, there was a certain improvement in the service for a time, but the company is now apparently resigned to its fate, and doesn't appear to care whether it gives satisfaction or not. Inattention to the bell, delays in switching through, connection with wrong numbers—these seem to be inseparable from the present telephone system of London.

Lord Kelvin.—The *Athenæum* says that Lord Kelvin proposes to give a valedictory address to the Mathematical Society, the title being "On the Transmission of Force through a Solid."

NEW COMPANIES REGISTERED.

London Electric Warehouse Company, Limited (67,568).—This company was registered on October 25th, with a capital of £1,000 in £10 shares, to carry on the business of electrical engineers, electricians, suppliers of electricity, manufacturers of, and dealers in, electrical machinery, plant, and apparatus, producers of light, sound, and power by electricity and otherwise, dealers in iron, india-rubber, asbestos, and chemical and metallic substances, &c. The first subscribers (each with one share) are:—W. L. Magden, 47, Lower Belgrave Street, S.W., electrical engineer; F. J. Magden, 39, Park Crescent, Brighton, electrical engineer; J. S. Fraine, 7, Lovaine Place, Newcastle-on-Tyne, electrical engineer; A. D. Foster, 10, Osbaldeston Road, Stoke Newington, N., clerk; R. H. McClellan, 14, Landseer Road, Bow, E., clerk; R. J. Denman, 21, Carroun Street, Kennington, S.E., clerk; and E. Wright, 78, Cheapside, E.C., chartered accountant. Registered without articles of association. Registered office, 78, Cheapside, E.C.

Yorkshire Electric Power Syndicate, Limited (67,574).—This company was registered on October 25th, with a capital of £10,000 in £10 shares, to carry on in the West Riding of Yorkshire, south of the River Wharfe, or elsewhere, the business of an electric power supply company in all its branches. The first subscribers (each with one share) are:—A. G. Lupton, Wellington Street, Leeds, cloth manufacturer; C. L. Mason, The Hollies, Cliff Road, Leeds, retired bank manager; R. Heedson, Gildersome Foundry, Leeds, engineer; A. C. Briggs, Gedlow Grange, Leeds, colliery proprietor; L. Marcan, Allestree, Weetwood, Leeds, wool merchant; S. Ingham, Headingley Hall, Leeds, timber merchant; and W. G. Jackson, Whitwood Collieries, Normanton, mining engineer. The number of directors is not to be less than three nor more than twelve; the subscribers are to appoint the first. Registered office, 7, St. Helen's Place, E.C.

Rowell, Stuart, Kelman & Co, Limited (67,575).—This company was registered on October 26th, with a capital of £100,000 in £5 shares, to acquire the business carried on by Rowell, Stuart, Kelman & Co., of 27-8, Broad Street Avenue, E.C., the business carried on by the World Gas and Electric Syndicate, Limited, of Winchester House, E.C., and the concessions and contracts of the Railway, Tramway, and Waterworks Construction Company, of Gracechurch Street, E.C., and to carry on the business of electricians, electrical, gas, and general engineers, railway and general contractors, suppliers of light and power, &c. The first subscribers (each with one share) are:—C. S. Kelman, 27-8, Broad Street Avenue, E.C., contractor; J. A. Kelman, 251, Winchester House, E.C., solicitor; D. E. Kelman, 51, Highbury New Park, N., merchant; E. N. Kelman, Denstone, Rochester, N. Staffordshire, student; D. Sluter, 251, Winchester House, E.C., secretary; S. Gibbs, 17, Royal Parade, Blackheath, accountant; and R. W. Blackburn, Elm Villa, Whitta Road, Manor Park, E., shipping clerk. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; qualification, 50 shares.

SUPPLY STATION ACCOUNTS.

Southport Corporation Electricity Accounts.

Last June, when we dealt with the Southport Corporation electricity accounts for 1898, we characterised them as "very favourable." Last year's accounts of the undertaking, with which we now have to deal, present some features which are becoming frequent, and to give them their true value, it has to be remembered that as rates of charge are reduced in face of rising market values, Corporation accounts must be considered rather on a broad basis than by the too common method of looking only at the net financial result. For example, in this instance the gross profit has increased by £823, but the financial charges have gone up by a larger sum, namely, £1,071. Notwithstanding this, we consider that, for an output of under 700,000 units, Mr. C. D. Taite may be satisfied with the figures.

General Statement.

	1898.	1899.	Increase.
Total capital expenditure ...	£76,179	**£102,747**	£26,568
Number of units sold	589,350	**696,060**	106,710
Maximum load in KW.	591	**666**	75
Gross revenue	£9,383	**£11,348**	£1,965
Gross expenditure	£3,822	**£4,964**	£1,142
Gross profit	£5,561	**£6,384**	£823
Average price per unit sold ...	3·80d.	**3·90d.**	+·10d.

The revenue shows the rather unusual change indicated by a plus sign before the alteration in receipts per unit. In 1897 the receipts from all sources amounted to 4·25d. per unit and fell to 3·81d. in 1898. Last year the figure was 3·91d. As the capital expenditure in 1899 was double that of 1898, and the output and load increased less rapidly than in the preceding year, it is probable that the current year's accounts will show a rapid growth again when the plan and other extensions are available for use.

Revenue Statement.

	1898. Gross.	1898. Per unit	1899. Gross.	1899. Per unit.	Increase.
Sale of energy	£9,342	3·80d.	£11,312	3·90d.	+·10d.
Meter rents	29	·01d.	36	·01d.	·00d.
Supply of lamps, &c.	...	...	...	...	...
Sundry	12	...	...	...	...
Gross revenue	£9,383	3·81d.	£11,348	3·91d.	+·10d.

In the "costs" coal is higher than in 1897 or 1898, as might be expected. The other changes are trivial, the net result being about ½d. rise in works and total costs, the latter is still, however, well below 2d.

Cost of Production.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Coal, and unloading same	£781	·32d.	£1,262	·43d.	+·11d.
Oil, waste, water and engine room stores	222	·09d.	267	·10d.	+·01d.
Salaries and wages incurred in generation and distribution and attending public lamps	1,339	·55d.	1,552	·53d.	−·02d.
Repairs and maintenance of buildings, engines, boilers, dynamos and street lamps	429	·17d.	551	·19d.	+·02d.
Works cost	£2,771	1·13d.	£3,632	1·25d.	+·12d.
Rent, rates and taxes	276	·11d.	344	·12d.	+·01d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	437	·18d.	517	·18d.	·00d.
General establishment charges, stationery and printing, law charges and insurance	338	·14d.	471	·16d.	+·02d.
Other expenses	...	...	...	...	...
Total costs	£3,822	1·56d.	£4,964	1·71d.	+·15d.

Whereas in 1898 only £620 was paid toward relief of the rates, a sum of £1,500 is now appropriated in this way. Whether it would not in the long run be sounder policy to create large reserve and depreciation funds is a question. A thousand pounds or so cannot affect the rating appreciably, and the undertaking might find it beneficial to have cash at its disposal in the event of engineering contingencies calling for extraordinary expenditure.

Profit Statement.

	1898.	1899.
Interest on loans	£1,920	£2,521
Sinking fund for repayments	1,613	2,083
Net profit carried to credit of rates	620	1,500
" " " forward	...	280
" " " to credit of capital account	1,408*	...
Gross profit	£5,561	£6,384

* To credit of capital account £1,204, and "disallowance by Local Government Board £204."

The manner in which the output is distributed is shown by the figures now set out:—

	Units generated.	Units. Private supply.	Units. Public lighting.	No. of public arc lamps.
1897	532,862	291,277	85,213	42
1898	809,289	501,005	88,345	42
1899	985,334	607,002	89,058	42

CITY NOTES.

The Monte Video Telephone Company.

The annual general meeting of the shareholders of this company was held on Wednesday at Winchester House, Old Broad Street, Mr. Frank W. Jones presiding.

In proposing the adoption of the report, the Chairman said that the results for the period under review at the last meeting were the best that had ever been laid before them, and he was very pleased to state that those for the past year were still better. While the immediate prospects were not in favour of any great increase of business during the present year, he might say that, so far, there was promise of an improved revenue. The more distant future was of much greater promise. Monte Video was not a city of rapid growth, but a steady increase in population and business went on, and seemed likely to continue, and, in the opinion of many, a much greater improvement than ever would before very long be shown. The new port works were now believed to be assured, and must have an exceedingly favourable effect upon the whole of Uruguay, and more particularly upon Monte Video. While it would be difficult to estimate with any degree of exactness the extent of that benefit, it was believed that its effect in Monte Video would be very great indeed, and would turn what had hitherto been considered a not particularly active locality into a busy sea port, equalling, if not surpassing, any in South America, excepting Buenos Ayres. In reviewing the accounts, the first item in which there was any change from the one of last year was sundry creditors, the increase of which, £1,553, was attributable to the purchase of a new property for the Cordon office. Depreciation fund, £8,000, remained the same. Reserve fund was increased last year by £2,700, £200 more than appeared in the accounts for the year, that sum having been transferred from the amount written off accounts of bad debts, as it subsequently appeared that such portion was an excessive writing off. The reserve fund now standing at £13,000, it is proposed to increase by £3,500. The final item on the side of liabilities, profit for the year, £9,269, was very satisfactory. The corresponding figures for the preceding four years were:—1896, £5,727; 1897, £6,237; 1898, £6,826; and 1899, £8,227. It would be seen that the business has been steadily progressing. On the assets side the ordinary capital expenditure showed an increase of £217 over the previous year, the stock of materials an increase of £204, and sundry debtors, £204. Under the heading of investments, real estate in Monte Video was increased £2,915, consequent upon the purchase of the Cordon property above referred to. They now owned as freehold their central and the two chief sub-office properties, and were no longer at the mercy of landlords and at the risk of exorbitant rents on their account. Turning to profit and loss account, the working expenses at Monte Video increased £684, attributable to an increase in the maintenance charges through a greater number of subscribers. The London office expenses decreased £223, mainly through the reduction in the number of directors. In continuation of the policy of the board to write down the assets to actual values, they had again written off £300 from stock of materials, bringing that item on the balance-sheet to what the board believe was now a thoroughly reliable figure. On the credit side of the profit and loss account the sum £19,446 for "subscriptions, &c.," was an increase over the previous year of £1,138. The result on balance showed a profit of £9,269, as against £8,227, or something more than a 10 per cent. increase of profit for the year. The appropriation of the profit and the balance from the previous year, a total of £11,527, had received the very careful consideration of the board. Had they capital at command for anticipated expenditure in improving and extending the business, there would have been no hesitation in recommending a higher dividend on the ordinary shares, but such a course could not be recommended without reliable reserves for future capital expenditure. They could not tell when or how soon demands for such expenditure might be made upon them that would tax their efforts to the utmost. They could not lose sight of the fact that improvements in telephony were likely to require new instruments, switchboards, and other appliances, that extensions must constantly be made, and that an underground plant was to be looked forward to. Some shareholder, closely examining the accounts, might have thought that while they showed earnings for the past year of over 6 per cent. on the ordinary shares, they recommend the payment of only 2½ per cent. They all knew that earning a dividend and having the amount intact at the end of the year were not the same thing, and he thought that their accounts, when considered with care, showed conclusively that the directors had recommended all the dividend on the ordinary shares that the circumstances warranted.

Mr. C. Lock seconded the motion, and the report was adopted.

Eastern Extension Telegraph Company.

The report of the directors for the half-year ended June 30th, to be submitted to the meeting to be held in London on 7th prox., states that the gross receipts amounted during that period to £313,227, against £324,361 for the corresponding half-year of 1899. The working expenses, including £28,261 for maintenance of cables, absorb £108,660, against £107,267 for the corresponding period of 1899, leaving £204,567. From this is deducted £5,630 for income-tax, £13,984 for interest on debentures, debenture stock, and contribution to sinking fund, £5,000 for the reserve fund in connection with the proposed removal of the head offices, and £500 towards the Indian famine fund, leaving £179,453 as the net profit for the half-year. Two quarterly interim dividends of 1½ per cent. each, amounting to £62,500, have been paid for the half-year, leaving £116,953, from which £120 has been deducted for dividend on new shares, and £100,000 transferred to the general reserve fund. The balance of £16,833 is carried forward. During the half-year the unissued balance of 50,000 shares of the company's share capital was issued to the shareholders at a premium of £3 per share, or £13 each, and an official quotation has since been obtained. The balance of 5 per cent. Australian Government subsidy debentures has been paid off with the exception of 18. The duplicate cable between Victoria and Tasmania has been partially renewed at a cost of £13,239, which has been debited to the general reserve fund. The necessity for improved telegraphic communication with the North of China having been demonstrated by recent occurrences in that country, the company, in conjunction with the Great Northern Telegraph Company, have been able to meet international requirements by providing, at short notice, from their stocks of material in the Far East, cables between Shanghai, Chefoo and Taku, with branch lines from Chefoo to Wei-hai-wei, Port Arthur and Kiaochau. These cables have been opened to the public without any additional charge being levied on traffic exchanged between China and Europe.

Western Telegraph Company, Limited.

The meeting of this company was held on Tuesday at Winchester House, Mr. W. S. Andrews presiding.

The Chairman said that the even course of their prosperity continued, and circumstances so far confirmed the wisdom of the arrangements made to bring the two companies together. Joint-working had been more advantageous than separate working. This was the first half-year's accounts to contain the receipts and the

through a Solid."

and other extensions are available for use.

expenses of the united system. The income for the half-year ended June 30th, 1900, including dividends from other telegraph companies amounted to £230,435, against £226,217 for the previous corresponding half-year, a net increase of £4,218. That, however, baldly stated, would be rather misleading, because, as a fact, the income derived from messages, registrations, amounted to an increase of £17,374, the difference between the two being occasioned by the amounts of dividends that they received from other companies which varied. If they were to compare the revenue with the previous corresponding half-year, omitting the question of dividends, they had a net increase of some £36,000, consequently they were progressing in a very satisfactory manner in the revenue. The current half-year up to the present showed that the revenue promised to be even more encouraging. The expenses for the period under review were not so pleasing. The total expenditure for the half-year was £80,000, and that for the previous half-year £71,000, an increase, therefore, of £9,000, but that did not look very formidable when examined. The increase was chiefly due to expenditure falling upon the current year, which was not of a permanent character. For instance, the *Norseman* had been home and was going out almost immediately. The purpose of bringing her home was for repairs and the application of certain alterations in the machinery, which they believed would result in more economical working. The addition for repairs of cables account came to £3,000; then there was the supply of new cables, electrical stores, instruments, and so on, at a cost of £2,000. Other items showing increases were alterations to stations, directors' fees, pension and staff assurance funds. After payment of £11,032 for debenture interest and sinking fund, and providing for payment of income-tax, there was a credit balance of £135,613, to which had to be added £6,791 brought forward, making altogether £142,404. Deducting expenses of debenture issue and interim dividend, there was a balance of £110,554. £50,000 of that was transferred to reserve, and out of what remained they recommended a final dividend of 3s. per share, making 6 per cent. for the year and a bonus of 2s. per share. This would require £51,892 and leave £8,571 to carry forward. They hoped to complete their line of new cables without impinging very greatly upon the reserve fund. There had been at present no increase in the share capital on account of the laying of those new cables, their fund enabling them to go on to their completion—in fact, the last section had just gone out, and they would have laid altogether for the greater accommodation of Brazilian and other interests in South America 1,275 knots, 1,437 knots, and 1,219 knots, making a total of 3,932 knots, and with the final cargo the ship sailed on October 27th. Those cables were of the very best and most modern construction, and they were calculated to give high speed and to provide therefore direct circuits which would transmit a larger number of messages than the ordinary circuits. They would, of course, draw upon the reserve to the extent that was necessary. The *Norseman* was expected to go out very soon—certainly by Christmas—and the effect would be that when she was on the station those larger expenses on account of the hiring of ships to replace her during absence would cease, and they would get back to the normal expenditure for shipping purposes.

The adoption of the report was seconded by Mr. Frederick Youle, and unanimously adopted.

The retiring auditors having been re-elected, the meeting became extraordinary, and passed the following resolution after the chairman had briefly explained it:—

That the articles of association of the company be and they are hereby altered in manner following, that is to say, there shall be added on to the end of the 110th of such articles the following words, namely:—"Every past, present and future director who has been or is or shall become a director of any other company as the nominee of this company may, in addition to any remuneration received by him under the preceding provisions of this article, also retain for his own benefit any remuneration to which he has become or may hereafter become entitled as a director of such other company, whether his qualification for such directorship shall or shall not be held by him in trust for this company."

The chairman explained that the Plate line that they had acquired an interest in was one connecting Uruguay, Buenos Ayres, and the Argentine Confederation, and it linked up important lines to the Pacific, that is, to the West Coast of South America with the lines of this company to and through Brazil. The line was a short one, and had been hitherto worked by an independent company, with separate stations, its own tariffs, rules, and regulations, working as a separate local section, but interposed, so to say, in this company's through connections. This was manifestly detrimental to the telegraph service, and in the interests of direct and speedy communication, homogeneous management, and furtherance of public interests, it called for improvement and alteration. They proposed to bring this concern under their own management, and the same remark applied to other undertakings; in fact, this was a part of what he might call a general measure, although that general measure was not yet ripe and could not then be described. These steps were taken to produce simplicity and unity of management, and ultimately the concerns would be assimilated, though in Brazil it was impracticable to at once make arrangements for assimilation by absorption. They were consequently compelled to keep the line under a legally separate board. The River Plate business was a small affair, showing a very excellent return; they had paid £60,000 for it. Not only, therefore, would they make an arrangement which would pay but would also lead to improved working. In answer to a shareholder, it was stated that it was proposed eventually to amalgamate the River Plate Company with the Western Telegraph Company, and it was proposed that the directors should be allowed to be paid for any work they might do in connection with that or any other company, but after amalgamation they would cease to be paid.

The resolution was seconded by Mr. J. D. Pender, and carried unanimously.

St. Helens Cable Company.

We are informed that this company held its first annual meeting on October 31st at St. Helens.

Mr. Heyl-Dia, who presided, reported that the progress of the past 13 months was so satisfactory that although the Warrington electric cable works had only been working for the past six months, the board was in the pleasant position of being able to recommend that a dividend of 6 per cent. on the ordinary shares be declared and paid forthwith. The prospects of the company were as bright as could be wished, as the works were going night and day, and the continued addition of new plant was being fully occupied as it was put down. The report was adopted unanimously.

Cape Electric Tramways Company.

The report of the directors for the year ended June 30th, to be presented at the meeting to be held in London on 14th inst., states that the profit and loss account on the 12 months' working, after provision for debenture interest, shows a net balance to credit of £65,204, which, added to £15,615 brought forward, makes a total available of £80,820. From this the directors have paid to the shareholders 9 per cent. upon their capital, represented by two interim dividends. The directors have also placed to the credit of the reserve £8,000, and have created a special reserve, to the credit of which they have placed £12,000. These sums (including interim dividends) aggregate £56,000, and leave £24,820 to be dealt with. From this provision has to be made for the remuneration of the directors. With regard to the disposition of this remaining balance, the directors recommend a bonus of 3 per cent. upon the capital, which will absorb £12,000. During the 12 months' working the Cape Town system has carried 11,332,627 passengers, as against 8,489,490 passengers in the preceding year. The Port Elizabeth system has carried 2,967,420 passengers, as against 2,563,259 passengers in the preceding year. The grand total of passengers carried on both systems for the preceding year was 11,052,749. For the year under review the total number is 14,300,047, which shows an increase of 3,247,298.

R. Waygood & Co.

The statutory meeting was held at the Bridge House Hotel, London Bridge, on 29th ult.—The Chairman said the company was successfully floated on June 29th last. The capital, £210,000, was considerably over subscribed, applications having to be returned for £100,000, and none was underwritten. Notwithstanding that trade generally has not been so good, the amount of orders received since March 31st, the date from which the new company took over the business, had been in excess of those received for the similar period in any year. The book debts as shown in the prospectus amounted to £41,975. They had already realised £35,297, and the balance to be collected, it was estimated, would produce at least the full amount in the prospectus, and most probably more. The trade debts were taken on at £21,849; of this amount £20,213, had been paid. Owing to the expansion of business the company was erecting additional buildings. It had completed the purchase of a row of houses between the works and the street, and thus obtained a considerable addition of space adjoining the factory for future expansion.

Official Announcements re Companies.

Notice appeared in the *London Gazette* on Friday last to the effect that the following companies have been struck off the register:—

Battery and Motor Company, Limited.
British Association of Medical Electricians, Limited.
Canton (Waipori) Mining and Electric Power Company, Limited.
Capital and Counties Electricity Supply Company, Limited.
Capsule Battery Company, Limited.
Corbridge Electric Lighting Company, Limited.
Cruto Incandescent Lamp Agency, Limited.
Devon Traction and Motor Company, Limited.
Electric and General Contract Corporation, Limited.
Electric Free Wiring Syndicate, Limited.
Electric Meter Company, Limited.
Electric Racing Horse Maze (Pioneer Syndicate), Limited.
Electric Steam Syndicate, Limited.
Electrolytic Separation Syndicate, Limited.
Elieson Lamina Accumulator Company, Limited.
European Electric Finance Company, Limited.
Gravier Dynamo Syndicate, Limited.
Improved Incandescent Electric Lamp Syndicate, Limited.
Johnson's Supplementary Steam Generator Company, Limited.
Llandudno Electric Supply Company, Limited.
London Electrical Carriage Company, Limited.
London Electrical Coupé Company, Limited.
London Electrical Van Company, Limited.
London Health Electrical Institute, Limited.
North London Electric Supply Company, Limited.
Peerless Accumulator Syndicate, Limited.
Water-Tube Boiler Syndicate, Limited.

The following will be struck off the register within three months unless cause is shown to the contrary:—

Electric Horse Promotion Syndicate, Limited.
Freudenberg's Automatic Telephone Syndicate, Limited.
Freudenberg's Multiple Telephone Syndicate, Limited.
Improved Telephone Patents, Limited.
Premier Electricity Meter Company, Limited.
Vice-Versâ Portable Electric Lamp Syndicate, Limited.
Whitstable Electric Light and Power Company, Limited.

for the Cordon office. Depreciation fund, £8,000, remained the same. Reserve fund was increased last year by £2,700, £200 more

arrangements made to bring the two companies together. Joint-working had been more advantageous than separate working. This was the first half-year's accounts to contain the receipts and the

Stock Exchange Notices.—The Committee has ordered the undermentioned securities to be quoted in the Official List:—Dublin United Tramways Company (1898) Limited—60,000 ordinary shares of £10 each, fully paid, Nos. 1 to 60,000; 59,987 6 per cent. preference shares of £10 each, fully paid, within Nos. 1 to 60,000; and £300,000 3½ per cent. mortgage debentures of £100 each, Nos. 1 to 3,000.

Electric and General Investment Company.—Allotment letters in respect of the issue of 19,900 6 per cent. cumulative preference shares were posted on Tuesday.

West India and Panama Telegraph Company.—A dividend of 6d. per share is announced on the ordinary shares.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending October 27th, 1900, were £217; corresponding period last year, £238: decrease, £21. Total to date, £18,881; corresponding period last year, £18,871; increase, £10.

The Bristol Tramways and Carriage Company.—The receipts for the week ending October 26th, 1900, were £2,973 6s. 5d.; corresponding period last year, £2,905 13s. 5d.; increase, £67 13s. 0d.

The Central London Railway.—The receipts for the week ending October 27th, 1900, were £6,102; previous week, £5,465; increase, £637. Total receipts to date (13 weeks), £64,498. Miles open, 6.

The City and South London Railway Company.—The receipts for the week ending October 28th, 1900, were £1,866; corresponding week last year, £1,045; increase, £821. Total to date, £26,458; corresponding period last year, £16,299; increase, £10,159. Miles open, 1900, 4¾; 1899, 3¾.

The Cork Electric Tramways and Lighting Company.—The receipts for the week ending October 25th, 1900, were £413 10s. 4d.; corresponding week last year, £403 3s. 6d.; increase, £10 16s. 10d. Total to date, £17,876 18s. 3d.; corresponding period last year, £16,412 19s. 7d.; increase, £1,463 18s. 7d.

The Dover Corporation Tramways.—The receipts for the week ending October 27th, 1900, were £181 6s. 8d.; corresponding week last year, £179 19s. 10d.; increase, £1 0s. 10d. Total to date, £9,056 6s. 10½d.; corresponding period last year, £8,643 3s. 11d.; increase, £413 2s. 11½d. Miles of track open, 3. Car miles run, 1900, 4,978; 1899, 4,794. Number of cars, 11.

The Dublin United Tramways Company.—The receipts for the week ending October 26th, 1900, were as follows:—D. U. T. Co., horse cars, £25 8s. 5d.; ditto, electric cars, £3,403 6s. 5d.; D. S. D. Co., electric cars, £740 18s. 1d.; total, £4,169 12s. 11d; corresponding week last year—D. U. T. Co., horse cars, £883 10s. 9d.; ditto, electric cars, £2,544 11s. 0d.; D. S. D. Co., electric cars, £739 17s. 2d.; total, £3,767 18s. 11d.; increase, £401 14s. 0d.; aggregate to date, £82,717 2s. 3d.; aggregate to date last year, £74,118 16s. 1d.; increase, £8,598 6s. 2d. The mileage worked is 44 miles electrically, 1 mile by horses, as against 35 miles electrically, 9 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending October 28th, 1900, were £1,518; corresponding week last year, £1,630; decrease, £112. Total from July 1st, 1900, £28,894; ditto corresponding period last year, £27,804; increase, £1,090. Miles open, 6·57 chains.

STOCKS AND SHARES.

Wednesday Evening.

What with the City's welcome to its "boys" on Monday, and the Stock Exchange holiday on Thursday, business has been extremely restricted in the general markets this week. Add, too, the fact that the current settlement is one of those which extends over 19 days, and nothing more need be said to account for the prevailing quietude. There is little in the position of the Money Market to encourage investment buying, and taking everything into consideration, the absence of business in the Stock Exchange is by no means remarkable.

Once again has the telegraph department been staggered by a sharp fall in Anglo-American Ordinary and Preferred stocks. Coming upon the top of such a heavy decline as took place last week, the market was unprepared for the still further fall, and at one time it looked as though the "B" stock would drop to 90. The lowest price touched was 93, and the Ordinary went to 50. It is peculiarly interesting to note how these prices compare with the highest and lowest of the last few years:—

Stock.	1897.		1898.		1899.		1900.	
	H.	L.	H.	L.	H.	L.	H.	L.
Anglo Ord. ..	60⅜	49	67	58	68¾	60	67¼	50
Anglo "B" ..	110	9⅛	117½	107	121	1.0½	117⅞	93

We have to go back to January, 1896, to find a lower price for the Preferred stock than that touched the other day, and the Ordinary has not been under 50 since 1897, as shown by our statistics. A slight recovery has set in since the lowest prices touched, but there is still a nasty loss on the week. Somewhat singularly, the Deferred stock has hardly budged an eighth per cent.

Direct United States shares are unchanged, but Submarine Cable Trust has moved up a little.

The news about the New South Wales Assembly having passed the Pacific Cable Bill had no effect upon the prices of Eastern stock and "China" shares. Doubtless the effect of the last scare on this account is too recent for investors to be troubled in the same way again, at least for some time to come. The New Eastern Extension shares, £3 paid, are in the vicinity of 7, and have just been admitted to the dignity of an official quotation. Globe Telegraph and Trust are weak, partly in sympathy with the fall in Anglo-American stocks, and West Coast of America shares, by a loss of 5s., have resumed their former quotation of half a sovereign.

In the Electrical Supply list the principal rises have been secured by Charing Cross and Notting Hill shares. The former have found strong supporters, and the company's latest issue of Preference shares, of which many proprietors refused the offer at 5½, are up to 5⅝. The general market is good throughout, and it is contended that the junkettings that will take place, and are taking place, at the return of the troops from South Africa, must work for good receipts by the electrical undertakings. Far-fetched as the suggestion seems, it is nevertheless doing duty to some extent in the market, City of Londons feeling its kindly influence the most. Chelseas are the only Ordinary shares that mark a decline, but as they are quoted *ex new*, the loss is not as bad as at first sight it would appear. The premium on the new shares have run off almost entirely, but shareholders entitled to an allotment should think twice before they refuse to accept it, since the new shares are likely to turn out a remunerative investment in the future.

The public are still buying Supply Debenture stocks, the market for which is as steady as ever. St. James's and Pall Mall 3½ per cent. Debenture stock is just par. A slight narrowing of the official quotations for County of London 4½ per cent. Debenture certificates goes for nothing at all.

Tramway shares are quiet, trade in them being as restricted as it is in other sections. British Electric Traction Ordinary have slightly recovered from their recent fall, but the Preference are unaltered. The strike on the Oldham system, to which we referred three weeks ago, is now in course of settlement, a London barrister having been accepted as arbitrator in the dispute. A new comer in this department will be the British Electric Street Tramways, Limited, which will have a capital of £300,000 in £10 shares. The company's title is surely a little close to that of the British Electric Traction? Anglo-Argentines are back a trifle, at 3 1/16, and no change is exhibited in Buenos Ayres and Belgrano "A" and "B" at 5 and 4 respectively. Calcutta Trams are 9½, and London Streets dull at 30s. for the fully-paid £4 shares.

National Telephone Ordinary are being pressed for sale, and have slipped back ⅛. Here, again, the fear of Government competition is the main skeleton in the cupboard, as the company is doing better business than ever. Another thing against the shares, of course, is the legal decision lately given in favour of a customer sued by the Telephone Company, it being apprehended that the following of a similar course in other instances might prove a serious matter for the N.T.C.

While quotations in the electric railway market are the same as they were a week ago, there has been a sharp rise in Metropolitan Railway stock on the definite plan now adopted for electrifying the line. Districts are also harder, and it is said that an influential American syndicate is buying the stock in order to gain control of the Board. We seem to remember having heard very similar stories on previous occasions when the insiders wanted to unload Districts. Central Londons are hard, the Deferred keeping steadily at ⅛ above the Preferred, thus emphasising the market opinion that a better dividend than 4 per cent. will be available for the junior shares. Everything naturally turns upon the question of the working expenses, which may be vaguely estimated between £2,200 and £2,800 per week, possibly nearer the latter than the former.

Manufacturing shares are better, particularly those connected with the telegraph trade. British Insulated Wire are flat, exceptionally. Callender's quickly recovered the deduction of 5s. dividend last Friday, and the market is a distinctly good one.

Of the reports published this week, the Eastern Extension showing is not as good as it was for the corresponding period last year, but the company, it is satisfactory to note, is acting partly in conjunction with the Great Northern Telegraph. The Cape Electric Trams report is excellent, and the dividend is to be at the rate of 12 per cent for the year, against the 6½ per cent. paid in 1898-1899. The capital of the company is to be increased by the creation of 100,000 additional Ordinary shares, and the terms upon which it is proposed to issue the new shares give an unusual amount of latitude to the directors.

The resolution was seconded by Mr. J. D. PENDER, and carried unanimously.

Vice-Versâ Portable Electric Lamp Syndicate, Limited.
Whitstable Electric Light and Power Company, Limited.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation October 24th.	Closing Quotation October 31st.	Business done during week ended October 31st, 1900. Highest.	Lowest.
110,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
125,000	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
875,520	Anglo-American Telegraph	Stock	3 %	£3 9s.	73/6	54 — 57	52 — 54	53½	51⅞
3,062,240	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	99½ 100½	96 — 98	100¼	95
3,062,240	Do. do. Deferred	Stock	...	18s. %	£1 7s.	10¼— 10⅝	10¼— 10⅝	10⅝	10 7/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	3 %	4 %	2½— 3½	3 — 3½	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	165 —175	165 —175	...	...
1,563,078£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	101 —103	101 —103	102½	102⅛
16,000	Cuba Telegraph	10	7 %	8 %	7 %	6½— 7½	6½— 7½xd	6 9/16	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	15 — 16	14½—15½xd	13⅜	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	4 — 5	3½— 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	100 —104 %	100 —104%	...	...
60,710£	Direct United States Cable	20	3¼%	3½%	3 %	10¼— 10¾	10¼— 10¾	10 11/16	...
111,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	149 —154	149 —154	150½	149½
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	99 —102	99 —102	100½	99¼
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	115 —120	113 —118 xd	...	...
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	14¾— 15¼	14¾— 15¼	14 15/16	...
6,700£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	...	...	... — ...	... — ...	...	...
26,600£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	...	...	... — ...	... — ...	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	114 —119	114 —119	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	99 —102	99 —102	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103%	100 —103%	...	...
180,227	Globe Telegraph and Trust	10	4½%	5⅛%	5¼%	10¾—11¼	10½— 11	11	10⅝
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15 — 15½	15 — 15½	15	...
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	12½%	...	32 — 34	31 — 33	31¼	...
84,300	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	98 —101	98 —101	98¼	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	49 — 53	48 — 52 xd	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	103 —106	103 —106	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680	1	...	...	2½%	¼— ⅛	¼— ⅛	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	4 %	5 %	⅜— 1	⅜— 1	...	...
490,000	National Telephone, 1 to 490,000	5	6 %	6 %	5 %	4⅜— 4⅝	4⅛— 4⅜	4 7/16	4¼
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 15	13 — 15	13	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 15	13 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	5 — 5¼	5 — 5¼	5 1/16	5
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 —99	96 — 99	97½	96
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5-%	5 %	5 %	⅞— 1⅛	⅞— 1⅛xd	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	...	...	100 —103	100 —103	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	124 —129	125 —130	125	...
58,000	United River Plate Telephone	5	5 %	6 %	7 %	4⅜— 5¼	4⅜— 5¼	...	...
16,639	Do. do. 5 % Cum. pref. Nos. 1—16,639	5	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
179,947	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	...	...	...	98 —101	98 —101	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— ⅝	...	...
150,000	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
389,731	Western and Brazilian Telegraph 4 % Deb. Stock Red.	Stock	...	...	...	... — ...	... — ...	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	7 %	14½—15	14½— 15	14⅝	14⅜
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	⅝%	2 %	⅝%	⅜— 1	⅜— 1	⅞	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	...	...	6½— 7½	6½— 7½	7 5/16	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	...	...	6 — 7	6 — 7	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	105 —108	105 —108	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	6 %	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref.	5	7 %	...	...	8½— 9½	8½— 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	9 — 10	9½— 10½	9⅝	9⅜
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5½— 6	5½— 6	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	6 %	6½— 7½	6 — 6½	6 9/16	6¼
150,000	Do. do. do. % Deb. Stock Red.	Stock	4½%	...	...	110 —113	110 —113	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000	10	10 %	6 %	4 %	8 — 9	8½— 9½	9	8⅝
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12½— 13½	12½—13½	13½	13 1/16
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	4 %	8½— 9½	8½— 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11 — 12	11 — 12	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd.	...	...	...	...	108 —112	108 —111	110	109⅝
26,100	Edmundson's Elec. Corp., Ord. Shares	5	5 %	7 %	...	4½— 5	4½— 5	4⅝	...
75,000	Do. do. 4½ % 1st Mort. Deb. Stock.	100	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	1⅝— 2¼	1⅝— 2¼	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	6 %	...	4½— 5½	4½— 5½	...	...
250,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	100 —102	100 —102	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	13½— 14½	13½— 14½	13½	...
220,000£	Do. 4½% First Mortgage Debenture Stock	...	4½%	...	...	112 —115	112 —115	...	...
220,000	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	97 —100	97 —100	...	...
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	14½— 15½	15 — 16	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15 — 16	15⅝	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8 — 9	8 — 9	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000	Do. do. 4 % Deb.	100	...	...	...	85 — 95	85 — 95	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3½	2½— 3½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	12 %	12 %	13 %	12 — 13	12 — 13	12½	12⅛

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

slight recovery has set in since the lowest prices touched, but there

to the directors.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation Oct. 24th.	Closing Quotation Oct. 31st.	Business done week ended Oct. 31st, 1900. Highest	Lowest
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	9 — 10	9 — 10	...	...
300,000	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	93 — 97	91 — 95xd	...	...
30,000	British Electric Traction	10	...	6 %	...	12½ — 13½	13 — 14	13⅞	13
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	12⅞	12⅛
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	120 —123	120 —123	122½	121½
85,000*l*	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	⅜ — ½	⅜ — ½	...	...
50,000	† Do do. 6 % Cum. Pref., 1—50,000 ...	...	...	...	...	⅜ — ½	⅜ — ½	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	97 — 99	97 — 99	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	15 %	15 %	20 %	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,000 ...	5	...	...	...	5⅜ — 6½	5⅜ — 6½	...	...
105,731	Brush Elecl. Enging., Ord., 1 to 90,000	2	3 %	5 %	6 %	1⅝ — 1⅞	1⅝ — 1⅞	...	...
105,731	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	6 %	2 — 2¼	2 — 2¼	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	106 —111	106 —111	...	...
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	102 —104	102 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	12½%	15 %	15 %	12½ — 13½	12½ — 13½	13¼	12⅝
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5 — 5½	5 — 5½	5⅝	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	110 —114	110 —114	...	...
213,533	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	10 — 10½	10 7/16	10 5/16
61,033	Do. do. Pref. half-shares	5	...	...	...	4⅜ — 5¼	4⅜ — 5¼	5⅜	...
71,447	Do. do. Def. do.	5	...	...	...	5 — 5½	5 — 5½	5⅝	...
855,000	City and South London Railway	Stock	1⅞%	2⅛%	1⅞%	58 — 61	58 — 61	...	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	5 — 6	5 — 6	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	6 %	7½%	3⅜ — 4¼	3⅜ — 4¼	3 1/16	...
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	6 %	1⅜ — 2¼	1⅜ — 2¼	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	6 %	3½ — 4½	3½ — 4½	...	...
344,023	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	90 — 92	90 — 92	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	2 — 2¼	2 — 2¼	2⅛	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	7 %	...	2⅜ — 3¼	2⅜ — 3¼	3 3/16	...
140,300	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	102 —105	102 —105	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600	10	7 %	7 %	7 %	10 — 11	10 — 11	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	15 %	12½ — 13½	12½ — 13½	13¼	12⅝
30,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5 — 5½	5 — 5½	5 7/16	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	...	...	108 —112	108 —112	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	20 — 21	20 — 21	20 1/16	...
300,000	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	99 —102	99 —102	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3½%	3⅝%	8¾ — 9	8⅞ — 9	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5	12⅜ — 13¼	12⅜ — 13¼	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	35 — 39	36 — 40	38	36½
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...%	101 —104	101 —104	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	...	8 %	12 %	10½ — 11½	10½ — 11½	11	10⅝
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5 — 5½	5¼ — 5⅝	5 9/16	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	94 — 97	94 — 97	94	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Brompton and Kensington, 4½ % Debentures of £100, 108—106.
National Electric Free Wiring, 12/6 paid, ⅜—½.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 16½—17½.
Do. do. Pref. (£10 pd.), 10—10½.
* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 % £5 (fully paid), 6¼—7¼. Debentures, 102—105. Dividend, 1899, on Ordinary Shares 11 %.
*T. Parker, £10 (fully paid), 17½.

Bank rate of discount 4 per cent. (July 19th, 1900).

MARKET QUOTATIONS, Wednesday, October 31st.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a ,, ,, ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£17 10	£17 10	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25	£25	..
a Lead, Nitrate	per ton	£25	£25	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8¾d.	8¾d.	..
a ,, Caustic (75/80%) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	64/-	64/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
a ,, Bichromate, casks ..	per lb.	2¾d.	2¾d.	..

METALS, &c.				
b Aluminium Wire, in ton lots..	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£80 to £150	£80 to £145	..
c Brass (rolled metal 2' to 12') basis	per lb.	7¾d.	7¾d.	..
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	8¼d.	8¼d.	..
c ,, Wire, basis	per lb.	8½d.	8½d.	..
c Copper Tubes (brazed) ..	per lb.	11¼d.	11¼d.	..
c ,, ,, (solid drawn) ..	per lb.	11d.	11d.	..
g Copper Bars (best selected) ..	per ton	£86	£85	£1 inc.

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£86	£85	£1 inc.
g ,, Rod	per ton	£86	£85	£1 inc.
e ,, (Electrolytic) Bars ..	per ton	£83 10	£83 10	..
e ,, ,, Sheets ..	per ton	£92	£92	..
e ,, ,, Rod ..	per ton	£85 10	£85 10	..
e ,, ,, H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha fine	per lb.	8/6	8/6	..
h India-rubber, Para fine ..	per lb.	4/- to 4/1	4/- to 4/1	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	64/5	67/9	3s. 4d. dec.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8 ..	per ton	£12 5	£12 5	..
g Lead, English Ingot	per ton	£17 15 to £17 17 6	£17 12 6 to £17 15	inc.
g ,, ,, Sheet	per ton	£19	£19	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 2 6	£9 5	2s. 6d. dec.
d Mica (in original cases), small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large ..	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£3 13 6*	£3 13 6	..
p Silicium Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£132 to £132 10	£132 to £133	..
g ,, foil	per lb.	2/-	2/-	..
n ,, wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals — "White Ant" brand	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10 lb. b'ndl's	per lb.	9½d.	9½d.	..
j ,, Best Flax, 6 lea.	per lb.	6d.	6d.	..
j ,, Hemp, 3 ply 10 lbs. ..	per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs. ..	per lb.	5½d.	5½d.	..
j ,, Jute, 180 lbs. rove ..	per ton	£14 10	£14 10	..
k Zinc, Sh't. (Vielle Montagne ond.)	per ton	£24 5 nett.	£24 5 nett	..

* Future £3 18

Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd. *c* Messrs. Thos. Bolton & Sons. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

Quotations supplied by { *f* India-Rubber, G.-P. and Teleg. Works *g* Messrs. James & Shakspeare. [Co., Ltd. *h* Messrs. Jackson & Till. *i* Messrs. Bolling & Lowe. *j* Messrs. Henry C. Yeo & Co.

Quotations supplied by { *k* Messrs. Morris Ashby, Limited. *m* Messrs. W. T. Glover & Co., Ltd. *n* Messrs. P. Ormiston & Sons. *o* Messrs. Johnson, Matthey & Co., Ltd. *p* The Phosphor Bronze Company, Ltd.

Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

THE PRODUCTION OF HIGH TEMPERATURES.

A novel and unexpected use for aluminium has been discovered, which adds one more proof that if a new substance can be produced, a use will be found for it. Aluminium is not a new substance by any means, but it is new to commerce, for it is only within recent years that its production in large quantities has been commercially possible. It is not a little remarkable in the newest application of the metal that, while the metal is so essentially a product of electricity, its new duty is that of assisting the conveyance of electrical energy.

The discovery to which we allude is that on which Mr. Lange has just read a paper to the Iron and Steel Institute. The reducing power of aluminium has, of course, been known for many years. A metal so tenacious of oxygen will, if started down the path of oxidation, rob all surrounding objects of their combined oxygen. Again, a metal that requires the high energy of the electric arc to separate it from its combined oxygen, will obviously give up a high energy when again put to work to absorb oxygen. This absorption has been brought under control, and made to serve as a means of producing high temperatures.

To take one example only of how the reducing property of aluminium may be utilised, we may cite the mixture of finely divided aluminium and iron oxide. Chemically, the reaction may thus be formulated:—

$$Fe_2O_3 + Al_2 = Al_2O_3 + Fe_2,$$

or metallic aluminium plus iron oxide produces metallic iron and oxide of aluminium. The iron oxide gives up its oxygen, and the aluminium is oxidised to clay. The operation may be conducted in a crucible lined with magnesite, which is exceedingly refractory. In this is first placed some of the iron oxide mixture. Next is added a good pinch of barium peroxide, or other oxide which will start the oxidation of the aluminium at a low temperature A little magnesium, and, perhaps, a little calcium carbide, will assist, or some of the nitrates or chlorates. The heat thus generated suffices to start the combination of the iron and aluminium mixture, and as this interaction proceeds, more and more is added, until finally the crucible contains metallic iron covered by aluminium slag. The temperature is intense, and the light compels the use of darkened glasses. The slag can be poured off and some idea gained of the temperature of the iron by pouring it on a mild steel plate or along the side of a mild steel bar, when it will be seen that the iron cuts its way with ease, like hot water poured upon ice. The temperature attained is, in fact, 2,900° to 3,000° C., or 1,000° above the hottest period of the Bessemer blow.

Aluminium may thus, in a sense, be looked on as a means for "storing the temperature" of the electric arc, by which it was first raised from bauxite, into which it again figuratively descends. The temperature of the electric arc is thus capable of being locked up, carried to a distance, and yet free to carry on operations requiring an electric arc temperature, but for which it is inconvenient or practically impossible to apply electricity directly. In this regard our attention may be perhaps most forcibly directed to the operation of rail welding. For this purpose a lower temperature is required than for reducing refractory metals, and the iron oxide may be diluted with sand, lime or magnesia. In this way temperatures can be regulated for various purposes, and for fairly low temperatures very crude aluminium of only 50 per cent. purity, made from bauxite, has a sufficient effect, and it matters very little how pure or impure the iron may be unless it is to form part of some structure.

At lower temperatures, therefore, we may obtain but a sintering mass, whilst at high temperatures pure iron is obtained with a liquid alumina slag; this slag, by the way, is carborundum, or artificial emery, with the advantage over emery that it has no combined water. In practice, however, it is at present thought better to use the high temperature reagents, but to use less of them, for low temperature work. The mixtures found best by Dr. Goldschmidt, of Essen, are two aluminium iron oxide mixtures, which cover most purposes. That for welding is called thermit P, and that for producing liquid iron thermit R.

Mr. Lange goes on to describe the welding of a 7-inch girder tram rail. The rails were placed end to end and clamped in a way that enabled them to be drawn together exactly as in electric welding. A sheet-iron form backed with clay was put round the joint and 15 kilos. of thermit P was placed in the crucible. In two minutes the now molten contents were poured into the joint box, care being taken that the protecting inert slag should first touch the parts and chill on them and protect them. In another two minutes the rail was adjudged to have arrived at a welding heat, and the clamp was operated and the weld effected; the solid mass round the joint is easily knocked away while still hot, though it is, perhaps, better to leave it for a time to prevent too rapid cooling. The sheet-iron form can be used again. If it can be shown that the cost of the process is less than the now heavy cost of drilling bond holes, cleaning them, and putting in the bonds, which are expensive articles, this new rail welding system is likely to come into considerable use.

Let us make a calculation of the mixture employed. We are told that about 33 lbs. are required for a joint, of a pure mixture of iron oxide and aluminium, almost exactly one-fourth of which is metallic aluminium. Thermit is by no means such a pure mixture; it probably contains a good deal of the diluting agents, such as sand or lime. In place, therefore, of 8 lbs. of aluminium, probably not more than 5 lbs. are employed, and pure aluminium is worth about 1s. per pound. The iron oxide is surely cheap enough, for we suppose it may be simply ground up hematite ore or furnace scale, or, perhaps, well rusted borings. The product is probably worth saving, the alumina slag for the emery mills and the iron for the scrap heap. Each pound of aluminium serves to produce 2 lbs. of iron, so that, on our assumption, the making of a rail joint ought to produce 10 lbs. of scrap iron and nearly 10 lbs. of carborundum. It appears to us that the labour ought to be very much reduced, especially if a better clamp than that illustrated by Mr. Lange was employed, such that it could be dropped on the rail, fixed and worked by the movement of one lever as it could easily be arranged to be worked, and removed with equal facility. An economy of thermit could be made if the hot iron knocked off previously made joints were piled round joints in advance of the welding work, so as to take off their chill.

It certainly seems reasonable to expect a big reduction in cost, for, be it noted, we have said nothing of the saving in bolts, fish-plates, and the labour of making the mechanical joint apart from the electrical bonding. Of course, electric welding is excellent, but it cannot be secured without plant or current.

The new system presents us with the temperature that cast-welding as hitherto tried fails to attain. Thus the huge lump of cast-iron must be left on the rail; in the new system the iron can be sold. Other applications of the process are the softening of spots on hard armour plate for the purpose of drilling holes for bolts and fixings. Steam pipes have thus been welded, pieces have been cast into broken cylinders, wheel teeth have been replaced.

It does not seem to us out of the way to suggest that the process appears to be capable of being worked up successfully as a means of repairing a broken screw shaft at sea or of welding up any broken part that may not be too large for such repair. We have, in fact, in a concentrated form a supply of intense heat energy. Metallic aluminium represents the result of a large electrical plant condensed in a form to be carried in a keg.

We may expect to see a very wide application of the process, even to such humble cases as the broken frame of a bicycle, round which a cast-weld could be made in the middle of a field remote from any workshop.

Mr. Lange made further reference to the process for the production of various metals and its use in metallurgy. The paper may best be studied as a whole for this purpose, though for rail welding we think special mention may well be given it.

SYSTEMS OF CURRENT DISTRIBUTION ON TRAMWAYS.

At the International Tramways Congress at Paris, M. Van Vloten presented a paper on distribution systems. While it is not possible to fix on any one system as the best for suburban lines capable of considerable extensions, *i.e.*, continuous, alternating, or polyphase, &c., it may be possible to deduce the merits or demerits of each mode of distribution, supposing one central station in each case.

1. When the line extends 8 to 10 km. from the station, with a not too close service, preference may usually be given to ordinary distribution by continuous current with or without batteries.

2. When the line extends 15 or 16 km. from the station, continuous currents with up and down transformers and batteries present advantages.

3. In certain special cases preference should be accorded to accumulator traction, when the line should not extend beyond 15 or 20 km. from the power house.

4. Continuous current distribution in series may be applied to still longer lines if water-power is available at a distance, but the system is not suitable for very variable service.

5. For these reasons polyphase distribution, with transformer stations to feed continuous current to the lines, is suitable for lines of 20 to 30 km., and for heavy and variable traffic, while it possesses advantages in utilising a distant fall of water.

6. Finally, direct polyphase distribution to polyphase motors with revolving fields, on the cars themselves, seems well adapted to regular railways only.

The merits and demerits are thus summed up for various systems.

(*a*) Ordinary 550 to 600-volt current, with feeders and return conductors, and one central station, has the merit of easy supervision from one centre, cheap labour, small reserve, large units, small cost per kilowatt-hour, security of service, good appearance of line, especially with buried cables, motors well fitted for the work of traction, and absence of danger. On the contrary, the cost of cables increases rapidly with distance, and there are heavy losses of pressure, and dangers of electrolysis and strong earth currents, and heavy depreciation charges.

(*b*) The same system, with accumulator sub-stations, helps to diminish the foregoing faults, especially on long lines, for accumulators enable the cable system to be calculated on the mean demand for current, and not on the maximum, in addition to the possibility of night charging.

A separate lighting system can also be fed off the battery.

(*c*) The same system with several stations permits, when the stations are well chosen as to situation, the increase of length of line according to the number of stations. It reduces the feeder section, diminishes the losses and the danger of electrolysis, and lightens the charge of depreciation, but the multiplication of stations raises the price of energy, reduces the ease of superintendence, enhances the cost of labour, and increases the reserve plant and the cost per effective kilowatt-hour and the depreciation charges of stations. Batteries have some of the evils of this system, which is only recommended where water powers are available along the line within easy distances.

(*d*) The same as (*a*), but with up and down transformers. The transformers compensate for feeder losses, and permit of the advantages of a single station with a reduced section of copper, while maintaining a good appearance of line and avoiding electrolysis. Transformers permit of the extension of the zone of action of an existing station without change of units. The system may be combined with the use of batteries. Against it is to be placed higher cost of the unit, and more complicated machinery. The system often possesses the advantages of the polyphase system, with sub-stations and converters.

(*e*) The three-wire system, with rail as neutral, serves notably to extend the radius of distribution from a single station with small cost per unit and reduced copper. Electrolysis is suppressed, and the neutral or rail costs nothing, while there are advantages of appearance, and of feeding a lighting system with arc lights. But in spite of this the system has not spread in face of its inconveniences and the frequent difficulty of coping with unequal demands, together with inconvenient construction and difference of polarity of the two lines, added to great complication of switchboard details.

(*f*) Continuous high tension current and secondary step-down stations to 550 volts have the advantages of high tension distribution, but the generators for continuous current are badly fitted for high tension and difficult to insulate, and their efficiency is slightly inferior to that of alternators and synchronous motors. Lines are costly to establish and more difficult to maintain than lines of alternating current at equal tension.

(*g*) The series distribution (System Thury) possesses the possibility of long-distance transmission at high tension with great reduction of copper and the putting into line in the same circuit many motors distinct and independent, as well as many stations equally distinct to serve for light or power.

The system offers the serious inconvenience of all systems of series distribution, namely, that the line loss is constant, no matter what the amount of work done, and the price of the unit is high when the duty is small and variable.

(*h*) Accumulator traction is not suited except for fairly level lines. It is cheap to instal on long lines of small traffic, being without conductors or posts. There are no dangers of electrolysis. The generators are small. Each vehicle is independent. Its rail adhesion is great, and there is an absence of danger. But the vehicles are heavy, wear and tear is great, the acid of the cells causes deterioration of trucks, &c., and disagreeable odours. Oversight and maintenance is difficult, while the batteries are not available beyond 15 or 20 km. without a recharge. This limits the distance worked from a single station.

(*i*) The combined system with accumulators permits of working lines over 15 or 20 km., but the accumulators are still less easily cared for and more subject to deterioration by reason of being charged in the vehicle itself.

(*k*) Monophase currents are not convenient for traction, because of the motors not starting on load, and there is much copper needed in conductors, with low efficiency.

(*l*) Diphase motors are impracticable, owing to the four conductors necessary. [Why *four*?]

(*m*) Triphase motors have the following advantages: large starting torque, high efficiency, constant speed at any load, rendering them suitable for heavy grades; the power of returning current to line on down grades. They are difficult to regulate as to speed, and require a small air gap with all the consequences of this in respect of bearings and small permissible wear.

Hence the triphase motor is best suited for level lines. It has no commutator, is very simple, and can use current at 1,000 to 4,000 volts.

The inconveniences of high tension are those of insulation for the line, the use of two conductors of different potential with all the complication of points and crossings overhead, and the general æsthetic objections. Then it is necessary to keep the voltage constant, because the motor speed varies as the square of the tension. There is often defective working due to the self-induction in the rails as third conductor and the many telegraphic and similar perturbations of serious moment, as well as public danger from high tension current. The advantage of transmission at high tension is great, and there is no electrolysis, but the system is unfitted for towns. The station may be placed where it can best obtain coal or water-power.

(*n*) The same system with transformers permits of high tension distribution and low tension feeding and reduces danger, but the efficiency is reduced by the transformation.

(*o*) Triphase currents may be transformed to continuous by synchronous alternators driving dynamos in continuous current sub-stations; or by low tension alternators with up transformers at the station and down at the sub-stations, with asynchronous motors and generators at sub-stations delivering continuous current; or high tension at the station, step-down transformers, asynchronous motors and generators at sub-stations delivering continuous current; or low tension alternators and up transformation at the station, with step-down and rotary converters at sub-stations; or high tension at the station and step-down transformers and rotary converters at the sub-station.

All these systems offer the following advantages:—Continuous current motors on the cars; ordinary overhead work; suppression of causes of signal apparatus derangement, as telephonic disturbances, &c.; safety to the public and railway servants; the power to use batteries; cheap primary distribution; one central station; the ability to utilise a water-power; and the unification of the line with ordinary urban and suburban installations. The inconveniences are the reduced efficiency due to transformations; the increase of copper in the low tension portions; the necessary supervision of the rotaries, which increases the cost per unit; the enormous plant, of a power, in all, much larger than that at the station.

The last-named system, with high tension alternators and rotary converters, is that adopted by the Marseilles tramways. Before all the rail potential difference had to be kept within 5 volts, and even within 1 volt near the termination of the submarine telegraph cables, as well as to avoid electrolysis. It was also necessary to provide elasticity of service and to forestall future extensions. The traffic could not be well foretold.

In the conditions of Marseilles the cable sections that had been adopted for continuous current did not meet the demands of the Post and Telegraph Department; hence the adoption of triphase current is admirably suited to the circumstances, permitting generation at one large station on a large scale and at a low price. The triphase system is the very best in point of return current to the numerous sub-stations, each with its own network with small and harmless currents, and with short returns, permitting the demands of the authorities to be easily met. Extensions can very readily be made, simply by adding to the sub-stations. Finally, with 5,500 volts, lines can be fed as long as 20 or 25 km. The system is looked on as the only practicable system, uniting, as it does, economy of installation and of working, an avoidance of danger of electrolysis, and the power of easy extension, a very desirable elasticity. Rotary converters can be coupled in parallel, as well as continuous current generators.

(*To be continued.*)

PHYSICAL SOCIETY.

Ordinary Meeting held October 26th, 1900.

Dr. Lodge, President, in the Chair.

Dr. Shelford Bidwell exhibited some "Experiments illustrating Phenomena of Vision."

A paper "On the Concentration at the Electrodes in a Solution, with Special Reference to the Liberation of Hydrogen by Electrolysis of a Mixture of Copper Sulphate and Sulphuric Acid," was read by Dr. H. J. S. Sand.

In this paper an equation has been derived for calculating the concentration at the electrode of a solution of a single salt, from which the metal is being deposited under the conditions (1) that the solution is contained in a cylindrical vessel bounded by the electrodes; (2) that no convection currents occur; and (3) that the diffusion of the salt obeys Fick's law, and its transport values are constant. This formula can be made the basis for roughly determining diffusion coefficients. In the case of mixtures, it is possible to arrive at limits for the concentration, and it has been experimentally proved that hydrogen always appears at the electrode of an acid solution of copper sulphate, in which no currents of liquid are taking place, between the limits of time for the concentration to go down to zero. The time which it takes for the hydrogen to appear can be calculated from an empirical formula, which is similar in form to the one used for a single salt. The great part played by convection currents in determining the ratio of the two constituents given off at the electrode of an acid copper-sulphate solution, has been shown by proving experimentally that artificial stirring causes hydrogen to disappear altogether in cases where it would otherwise have represented over 60 per cent. of the equivalents carrying the current from the solution to the electrode.

The Chairman drew attention to the fact that no hydrogen was liberated until all the copper had gone, and said the formula for the concentration might be used again in further investigations.

Dr. Donnan asked if the time at which hydrogen was liberated had been taken as the time at which hydrogen actually made its appearance in the form of bubbles, or whether any allowance had been made for saturation.

Dr. Sand said the time was taken up to the appearance of bubbles.

A paper by Dr. R. A. Lehfeldt on "Electromotive Force and Osmotic Pressure" was postponed until the next meeting, which is to be held on November 9th.

ELECTRICITY SUPPLY IN SMALL TOWNS.

At a meeting of the Incorporated Association of Municipal and County Engineers, held at Deal on September 14th last, a paper on the above subject was read by Mr. H. Boot, M.I.E.E., electrical engineer to the Tunbridge Wells Corporation. Tabulating a number of considerations to be taken into account in the preliminary steps towards laying down an installation, the author discusses them in detail—first naïvely remarking, however, that it is advisable to call in an expert to draw up a report. The author unreservedly favours the combination of lighting and traction stations under one roof and one management, but in order to get over the difficulty of overlapping of loads, he puts forward the astounding suggestion that "during the hours of lapping load it might be advisable, in the case of small towns, to 'horse' the tramways!" We need not point out the utter impracticability of such a proceeding. As an alternative, Mr. Boot suggests the provision of sufficient storage capacity to cope with the demand. This is infinitely more practical, and the advantages derivable from such a reserve, especially in the case of

small towns, are undeniably great, though we may add that it is as expensive a solution of the difficulty as would be the installation of sufficient generating plant to carry the maximum load. The author points out that the works can be put down at a cheaper rate per kilowatt combined than separate, as the machinery in the case of a lighting works, would only be used a very few hours per day, whereas if it were used for both purposes it would be almost in continual use, and the load factor would be improved. Quite so; but be it borne in mind that *all the gain is on the part of the lighting system, at the expense of the traction system.* This, no doubt, is no great matter in the case of a municipal undertaking, though it benefits the lighting consumers at the cost of the tramway passengers, and the latter are the more numerous, as well as the more diverse in social standing.

The author reiterates his advice that "a good practical expert, who *is* or *has* been employed in similar practical work, should be called in to advise on the selection of the site, the policy to be adopted, and the system used, afterwards engaging a resident manager to look after the commercial and technical sides of the undertaking, retaining the Consulting Expert, either by means of a percentage, or paying him an annual retaining fee. This arrangement enables small towns to obtain expert advice at a minimum expense." Remembering that small towns are in question, we are inclined to believe that a still cheaper and more satisfactory system is that which is so often met with now—namely, the lease of the provisional order by the municipal authority to a company of good standing, under an agreement empowering the former to buy the going concern at a definite price after it is firmly established on a paying basis. Almost invariably the direct current three-wire system is beyond question the most suitable, and to carry it into effect is a matter involving no higher engineering skill than is at the command of all such companies.

The author approves of the combination of destructors with electricity works, citing Llandudno and Shoreditch as examples, and states that the most satisfactory mode of working is to stoke some of the boilers with coal, these acting "as a reservoir of steam" and steadying the pressure.

A table of approximate capital outlay is given for installations of various sizes, which we find to agree fairly well with the rough rule:—Capital cost = £5,000 + 1·5 × L, where L is the equivalent number of 8-C.P. lamps supplied.

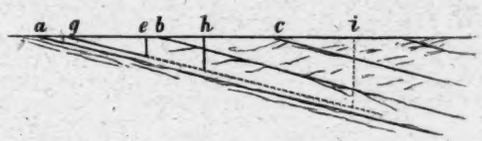
For the benefit of members of the association who were not well up in electrical terminology the author offered explanations which we feel bound to criticise. "Electricity is simply a *form of energy* existing in nature, which requires special machinery to set it in motion—the same way, as *in coal, there is no energy or life, until it is burning.* The measurement of electricity is composed of two factors. The product of the factors (when multiplied together) are termed 'watts.' *Either* factor may be altered, and yet the amount of *energy* would remain the *same.* For instance, one *unit of electricity* called the 'ampere,' multiplied by 100 units of pressure called the 'volts,' equals the *energy* which would be 100—or, it would equal 100 units of current multiplied by 1 unit of pressure." (The italics are ours.) Now, every one of the above italicised expressions, taken literally, is perfectly erroneous. Moreover, while it is important to be accurate at all times, it is still more important to use correct language before an audience of engineers who may not be sufficiently conversant with electrical terms to apply the necessary corrections.

The author gives some particulars of the water supply and cable system in use at Tunbridge Wells, followed by an explanation of the maximum demand system of charging and its effects. The development of a power load is advocated, as well as electric traction; the author also rightly points out the importance of public electric lighting to a small municipal undertaking, and approves of the policy of laying mains throughout the area of supply in advance of the demand.

THE COAL QUESTION IN ENGLAND.

In considering the question of the British coal supply, it is usually the custom to make calculations on the basis of the amount of coal that may be mined within the 4,000 feet depth, this being looked on as the limit of economical production. The factors which go to make it so are those of underground temperature, depth of shaft, and labour in winding the coal. When we view the enormous and unnecessary winding of rubbish from the pits of South Staffordshire and the surface wreckage produced by the withdrawal of so much underground material, we feel disposed to wish that these pits at any rate were much deeper so that this folly might cease, coal alone being wound up and the shales left below.

If, however, we leave the question of future or possible depths to be met with and perhaps overcome by the methods of ventilation and cooling and the systems of mining and winding that the necessity of the age will surely produce, we may look forward to possibly a much more extensive supply being secured. A study of the geological map of England and Wales will show that except over the whole of Cornwall, most of Devon, the greater part of Wales and that country of the millstone grit and mountain limestone that forms the Peak of Derbyshire, the Moors of Lancashire and Yorkshire and a great part of Westmorland, Cumberland, and Northumberland; we say excluding those portions, all the remainder of the surface of England and Wales is of more recent geological age than the coal formation. Speaking generally, the various geological strata are like the leaves of a book. Turn over page 1 and page 3 faces you, next comes page 5. There are notable exceptions to this order by sequence, but upon the surface along a line drawn from, say, Dungeness to Preston, occur with fairly regular sequence up or down the geological scale successive and conformably placed strata. If, therefore, to resume our simile of the open book we alight upon page 5, we may justify a certain confidence that the next page will be No. 7. Some years ago Messrs. Meux, the brewers of Tottenham Court Road, who saw that their brewery stood on page 1 and knew that page 3 was a stratum in which was usually found good water in other parts of the country, determined to find page 3 by boring a hole right through pages 1 and 2. Page 3, however, when reached proved to be very poor and faulty and of no account economically as a source of water, while page 4 was not there at all. Instead of page 4 the next stratum proved to be more nearly 24. In other words, the strata that outcrop on the line named above appeared to be missing: the borehole had, it was thought, touched the rocks which occupy a place below the coal measures, thus proving that coal, if it ever existed, had been swept away at some early age. The fact of these old rocks being found not merely at Messrs Meux's, but also at Kentish Town and later at Erith, points to the possibility of there being hidden away in some buried fold under South or East England more or less coal. This has, indeed, already been proved at Dover, and we believe it is not yet agreed among geologists whether the red rock found at the brewery was new red sandstone and not old red, in which case there would be an increased prospect of coal being found below it, the new red sandstone being at a higher level than coal. If in the sketch we represent by *a b* the breadth of country along which the coal measures crop out, then will any



vertical line as *e f* serve to represent a coal shaft. The coal may be worked at the point, *g*, where it actually comes up to the surface. It is so worked as well as by pits sunk at *e f*. But as geological knowledge and confidence have increased and appliances have improved, it has come about that the same seam that crops out at *g* has been proved at the point, *h*, which may be a long way beyond the boundary, *b*, that marks the surface limit of the coal measures. Similar reasoning tells us that the seam in all likelihood extends, it may be, to *i* or miles beyond even that point. In other words, wherever there is surface rock newer than coal, there is no reason why coal should not be found below at some depth. Of course faults and dislocations exist which render this agreeable prospect uncertain, as was proved in the case of London, which probably is carried by an underground range of hills that has really torn away or crumpled many of the leaves of our book of simile. That coal probably exists under all the new red series is pointed out to us by the occurrence of the Dudley coalfield standing out in a large area of newer rocks, through which the coal measures have been upthrust by the same agency that pushed up the still older Silurian rocks that now overtop the coal measures under Dudley Castle. Now the area of the surface of England that is occupied by the new red sandstone alone is much greater than the area of all the coalfields, while the areas of the next highest strata, the liassic and oolitic, are greater still, not to name the chalk area. Under much of this area there is undoubtedly coal at great depth, notably, too, the Nottingham coalfield is recognised as extending to an indeterminate distance east of the surface coal measures. Indeed, Shireoaks pit is itself situated on the permian or magnesian limestone some miles off the carboniferous area, while at Scarle, near Lincoln, carboniferous rocks were proved by a borehole at less than 2,000 feet. Thus the whole question of our coal resources is one of depth, and, of course, of production. Stanley Jevons endeavoured to make an estimate some years ago, but he arrived at figures far in excess of the since proved consumption. A late writer on the subject, M. Loze, finds himself unable to make positive statements. What the future may hold in the shape of improved methods we cannot foretell. Eventually, of course, all our coal must go, and eventually also must disappear the coal of every other nation. It is all a question of time when, if coal remains as now, the great source of warmth and energy, it will be exhausted—in far less time than the millions of years that were probably spent in laying it down. In such case this earth would be dependent for fuel on its timber growth, and for its power on water or wind.

Bearing on the question, we may cite the deep boring at Burford, in Oxfordshire, where coal measures were reached at a depth of only 1,184 feet from the surface, while at Dover the coal measures were first touched at 1,113 feet, and the bad financing of the Kent coal schemes generally cannot, fortunately, wipe out the facts. At Culford again, in Suffolk, bore-holes were made for water in the chalk, in the hope of finding the greensand below the chalk, and at 637 feet only, a rock was found that has been pronounced to be pre-carboniferous, thus confirming the evidences of Meux's well, Kentish Town, Turnford, and other deep bores, which, while not proving coal, have proved its possibility. As regards the temperature at great depths, there seems ample evidence to show that each 50 or 60 feet of depth may still be considered as marking 1° F., and should coal ever be won at depths beyond 4,000 feet, success will be achieved probably by the

full use of electrical coal cutters, electrical tramways in the mine, and copious local air supply, the endeavour being made to use specially cooled air at the working faces, and ordinary ventilation in other parts of the mine.

If coal is to be found at great depths, we may feel assured that the resources of civilisation are not yet so exhausted as not to devise a means of getting it out. In the annexed table are given the depths of a few of the principal deep borings, and the rocks in which they commenced at the surface, as well as the rock in which they finished:—

Surface formation.	Height above O. D.	Locality.	Depth.	Formation reached.
	Feet.			
London clay	6	Harwich	1,098	Carboniferous rocks.
Do.	18	Chatham Dockyard	965	Jurassic.
Do.	6	Crossness	1,060	? Trias or ? Devonian.
Chalk ..	110	Ware	832	Upper Silurian.
London clay	110	Cheshunt	1,010	Devonian.
Do.	85	Tottenham Ct. Rd., Meux's.	1,146	? Devonian.
Do.	183	Kentish Town ..	1,302	? Trias or ? Devonian.
Do.	17	Richmond	1,446	? Trias or ? Devonian.
Do.	110	Streatham	1,081	Lower Jurassic.
Chalk ..	109	Culford	637	Pre-carboniferous slate.
Middle lias..	..	Mickleton (Glouc.)..	1,342	New red.
Oolitic ..	..	Burford (Oxon.) ..	1,184	Carboniferous.
London clay	218	Winkfield (Berks.)..	1,234	Lower greensand.
Do.	98	Loughton (Essex) ..	1,096	Lower greensand.
Lias	? Low	Scarle	1,900	Carboniferous.
London clay	80	Stutton (Suffolk) ..	994	Palæozoic.
Chalk ..	? 30	Dover	1,113	Carboniferous.

It is remarkable that while nearly all the above deep bores commence in recent geological formation, they nearly all finish in old, if not in ancient rocks, and of those which finish in the Lower Greensand, there is no proof that at a little greater depth the same old rocks might not occur. The south-east of England is, in fact, built on a very old foundation. The lesson drawn from the borings that surround Essex, at Harwich, Stutton, Chatham, Ware, and Kentish Town, is that there is an area of 500 square miles of Essex under which coal may be found.

Since the above was written, an experienced geologist has expressed his opinion to us that even the English coalfields are hardly touched yet. He believes coal will be worked at great depths under the triassic rocks and others, and thinks it quite probable that a genuine use of liquid air might thus be worked up.

CURRENT SPECIFICATIONS.

XXXIV.—LOWESTOFT EXTENSION PLANT.

Summary.

Extent of Contract.—Section A.—Supply of two water-tube boilers, superheaters, extension of fuel economiser, &c. Section B.—Necessary pipe work as specified and shown on drawing supplied. Section C.—One 250-kw. steam dynamo.

Output of Boilers.—Each to evaporate 5,000 lbs. of water per hour at a working pressure of 160 lbs. per square inch, with average coal and cold feed.

Fuel Economiser.—64 tubes to be added to existing 96-tube Green's economiser.

Type of Engine.—To be of the vertical compound self-lubricating enclosed type.

Type of Dynamo.—To be of the multipolar pattern, suitable for working either as a shunt-wound machine at 460 to 500 volts, or as a compound from 500 to 550 volts at constant speed.

Speed of Combination.—Not to exceed 350 revolutions per minute.

Output and Overload.—To develop, as normal full load, 250 kw., and to be suitable for working without injury for periods of one hour at 25 per cent. overload. Dynamo to give, when working compound, 275 kw. (500 amperes at 550 volts) at full load, and of working for periods of one hour to 312·5 kw. without injury.

Permissible Temperature Rise.—After six hours' full load run 70° F. above surrounding atmosphere measured by resistance method.

Guaranteed Steam Consumption.—Not to exceed 34 lbs. per kw.-hour at normal full load, working non-condensing with ordinary dry steam at 150 lbs. per square inch pressure. Lowest guaranteed figures for three quarters and half load to be stated.

Date of Completion.—To be stated in tender for each section.

Penalty for Late Completion.—1 per cent. of the contract sum per week.

Terms of Payment.—80 per cent. as work proceeds, 10 per cent. on completion, 10 per cent. at end of 12 months' period of maintenance.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulation as to Wages paid to Workmen.—Trade Union rates for work in the district, where the goods are manufactured, to be paid.

Arbitration Proposals.—Satisfactory.

Date for Receipt of Tenders.—November 2nd, 1900.

This specification has been prepared by the consulting engineer to the Corporation, Mr. W. C. C. Hawtayne, M.I.E.E., and is another instance of the need for extension plant being ordered almost before the original station is well started.

It will be noted that the size of unit now proposed is 250 kw., and that so far as the technical requirements are concerned the specification is of a very open character, the principal limitation in the case of the steam dynamo being that the speed shall not exceed 350 revolutions per minute.

The boilers must be of the water-tube type, a separate price being given for superheaters to be added if required.

If the steam consumption guarantees are not fulfilled within 5 per cent., the plant is to be liable to rejection in whole or part.

The general conditions are, on the whole, of a very satisfactory character. Tenderers may make offers for any complete single section, or, if they prefer, one offer for the whole of the work. In the latter case it is well to bear in mind that the penalty for late completion of any one section is *1 per cent. of the total contract sum*, not *1 per cent. of the price of that particular section.*

The clause relating to wages paid to workmen reads as follows:—

> The contractor will be required to pay all men employed by him upon the works, the subject of this contract, the regular trades union rates of wages for the class of work done by such men in force at the date of his tender, and to observe the recognised trades union number of hours to be worked by them.

We should prefer that the wording of this clause referred to rates agreed upon between the trades unions and the local associations of employers, as cases have occurred in which the trades unions' demand for a certain rate differs from that usually paid in the locality, and has not been made the subject of agreement with employers.

The three clauses relating to strikes, maintenance and arbitration are of such a fair and reasonable character that they may be taken as models by other Corporations. While guarding the purchaser's interests, they do not conflict with the rules which govern safe commercial practice, and so may be accepted by contractors. They read:—

Clause 20—

> Should the works be delayed by reason of any inclement weather, fire, or causes not under the contractor's control, or in case of combination of workmen or strikes or lock-outs occurring in the building and engineering trades, and affecting the said works, due allowance shall be made by the engineer, and the contractor is to complete the works within such time as the engineer shall consider to be reasonable, and shall from time to time in writing appoint.

Clause 31—

> The contractor, notwithstanding any reasonable or usual use thereof by the Corporation or their agents, or any contractors employed by them in working the station, shall be responsible for and shall effectually maintain and uphold in good substantial, sound and perfect condition, fair wear and tear excepted, all and every part of the buildings, plant, machinery, &c., or other works supplied or carried out by them for the period of 12 calendar months from and after the day of the date of the completion thereof, and handing over to the Corporation, provided always that the contractor shall be only responsible during the said period of 12 months for any defects arising from bad materials, workmanship and design, and not for any accidents which may be occasioned by the negligence or incompetency of men in the employment of the Corporation, if they should otherwise than through the agency of the contractor work the station during the said period.

And Clause 33—

> Should any doubt, dispute, question, or controversy arise between the Corporation or their engineer as their representative, and the contractor touching the contract, or any matter in any way connected with the contract, or the operation thereof, or the rights, duties, or liabilities of either or any party or parties in connection with these premises, then either party may within 72 hours, but not later, give to the other notice in writing of the existence of such dispute or difference, and such dispute or difference may be referred to arbitration, which arbitration shall be deemed to be a submission to arbitration, within the meaning of the Arbitration Act, 1889.

Cardiff Tramway Plant.

In our issue of the 19th ult. we criticised under the heading "Current Specifications," the specification recently issued for electric traction generating plant by Mr. A. Ellis, the Cardiff Corporation tramways engineer. We have since received a letter from Mr. Ellis dealing, in the following terms, with several of the points there mentioned:—

"With regard to the first clause which you discuss, viz., that including penalties for late deliveries, &c., I cannot myself see that it can be very well misunderstood. In the present case we are having four engines and four generators, and the first two have to be completed by December 1st next year, the remaining two on January 1st and February 1st, respectively, 1902.

"There being four engines and four generators, there will be no difficulty whatever in obtaining the price of each set, and should the first two sets, for example, not be completed before, say, January 1st, which is four weeks late, 1 per cent. on the price of two generators per week will be deducted from the contract, and in the same manner with the remaining two generators.

"The clause is not supposed, nor do I think it conveys the impression that the penalty is only to take effect after the final date, viz., February 1st.

"I notice, on the other hand, that you do not give us credit for allowing a bonus to the contractors should they complete their work before the time specified. The bonus, like the penalty, will take effect in a similar manner."

In our criticism of the bonus and penalty clause referred to, we drew attention to the fact that the wording was "one per cent. on the contract price," and made the, to us, reasonable assumption that, since in the tender one sum only was given, it was *1 per cent.* of that figure which would be treated as the penalty or bonus amount per week. We are glad to find that the clause was intended to have a more liberal interpretation, since we think others fell into the same error as ourselves. In order, however, to guard our readers against any possible misinterpretation on our part, we printed the entire clause, that they might draw their own conclusions.

We do not understand the reference to an omission on our part to give credit for the offer of a bonus.

In our summary we stated:—

"*Bonus for Early Completion.*—One per cent. of contract price per week up to a maximum period of four weeks;" and the paragraph in our comments commence:—"Coming to the general conditions, we find that the provisions relating to penalty and *bonus* are not as clear as they might be, &c.," while in the reprint of the actual clause the portion relating to bonus is printed in italics to specially emphasise it.

Mr. Ellis gives us his interpretation of the fair wages clause in the following words:—

"You also warn contractors to be aware of the clause in the specification regarding standard rates of wages. I think this clause, likewise, is fairly clear, as it follows naturally in the case of engines and generators and boilers that the same will not be executed in Cardiff, so in this case the employers will not be expected to pay the Cardiff rate of wages, but the rate of wages as agreed upon between employers and employés in the town where the plant is being manufactured.

"As regards local wages, these would only refer to contracts which are being carried out in Cardiff itself, such as buildings, &c."

With regard to this, our comment was that if the above was intended, "*it may be accepted without in any way increasing the commercial risk of the contract.*"

Since a reference was made to obedience to trade regulations, we suggested inquiry as to the extent of a contractor's liability under this head.

We are pleased to find that the arbitration clause to which we felt it our duty to take strong exception has been withdrawn, and that it is intended in the final contract to substitute a new one. A copy of this has been sent to us, and we note that there is provision in the case of disputes for reference to an independent arbitrator to be appointed by the president for the time being of the Institution of Electrical Engineers. This is the principle for which we contended in our criticisms, and it is satisfactory to find that at the time of our writing, it was receiving the attention of the Council. Mr. Ellis is to be congratulated on his success in persuading his Committee to adopt a course which will commend itself as fair and just to all parties, and at the same time prevent any possibility of his being called upon to be counsel and judge of the same case.

Annual Dinner of the Institution of Electrical Engineers.—We are informed that the twelfth annual dinner of the Institution of Electrical Engineers will be held in the Grand Hall of the Hotel Cecil on Monday, December 3rd, and we understand that the Commander-in-Chief, Lord Wolseley, is among the guests who have already accepted.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1900.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

18,298. "Improvements in electric couplings." C. B. Walker. Dated October 15th.

18,337. "Improvements in electrical fuses or cut-outs and indicating carriers for same." W. H. Wood. Dated October 15th.

18,345. "Improvements in telegraphic codes." A. W. Greely. Dated October 15th.

18,347. "Switch apparatus for electrically-propelled vehicles." V. I. Feeny. (Allgemeine Electricitäts Gesellschaft, Germany.) Dated October 15th. (Complete.)

18,357. "Improvements in and in apparatus for taping insulated conductors." G. E. Heyl-Dia. Dated October 15th.

18,372. "An operating device for the regulating mechanism of the electric ignition of explosion motors." L. Schreiner and G. E. N. Michaux. Dated October 15th.

18,376. "Improvements in or relating to trolley poles for electric traction and power purposes." R. P. Strachan. Dated October 15th.

18,471. "Improvements in electric arc lamps." W. E. Pugsley, H. M. Descher, V. L. Douglass, and W. J. Robinson. Dated October 16th. (Complete.)

18,498. "Improvements in automatic guards or protectors for electric or other tramway cars." W. Dewar. Dated October 17th.

18,529. "Improved electric heat generator." L. Schramm. Dated October 17th.

18,534. "Improvements relating to electrically operated clocks." H. E. Andersson. Dated October 17th. (Complete.)

18,557. "Improvements in and connected with lightning arresters and high voltage guards or heating coils for telephonic purposes." H. Oppenheimer. Dated October 18th.

18,614. "Improvements in end play devices for rotary electrical machines." The British Thomson-Houston Company, Limited. (H. Geisenhoner, United States.) Dated October 18th. (Complete.)

18,615. "Improvements in electro-magnetic blow-outs or fuse boxes." The British Thomson-Houston Company, Limited. (E. M. Hewlett, United States.) Dated October 18th. (Complete.)

18,616. "Improvements in electric controllers." The British Thomson-Houston Company, Limited. (F. E. Case, United States.) Dated October 18th. (Complete.)

18,617. "Improvements in high potential electric circuit-breakers." The British Thomson-Houston Company, Limited. (E. M. Hewlett, United States.) Dated October 18th. (Complete.)

18,618. "Improvements in electrical indicating and measuring instruments." The British Thomson-Houston Company, Limited. (L. T. Robinson, United States.) Dated October 18th. (Complete.)

18,645. "Improvements in electric furnaces." A. Parker. Dated October 18th.

18,649. "Improvements in or connected with apparatus for making tubes of lead or the like, and for sheathing electric cables with lead or the like." H. Edmunds. Dated October 18th.

18,658. "A new or improved system of, and apparatus for, secret electric transmission." P. de Chimkevitch. Dated October 18th.

18,681. "Improvements in electric fire alarms." H. Simpson and R. Thomlinson. Dated October 19th.

18,706. "Improvements related to electrically-heated laundry irons and like appliances." J. Hayem. Dated October 19th.

18,718. "Improvements in magneto-electric ignition devices." W. Seck. Dated October 19th. (Complete.)

18,729. "Improvements in or connected with the generation of electricity." J. G. Lemon and G. Pirie. Dated October 19th.

18,741. "Improvements on those systems of electric tramways and railways in which current is collected from two insulated conductors (positive and negative), such improvements being in connection with crossings and turn-outs." J. Johnston. Dated October 20th.

18,742. "Improvements in electric lampholders." C. T. Briscoe. Dated October 20th.

18,757. "Improvements in safety devices for the trolley poles of electric cars." C. R. Bellamy, W. J. Turner, and D. R. W. Hardman. Dated October 20th.

18,779. "Improvements in electrical circuit closers particularly adapted for use with the indicators of railway signals." C. Cheal and H. J. Millner. Dated October 20th.

18,789. "Improvements in and relating to electricity meters." F. L. Catenhusen. Dated October 20th.

18,793. "Improvements in or relating to electric railways operated on the conduit system." W. Chapman. Dated October 20th.

18,794. "Improvements in insulators." W. Chapman. Dated October 20th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

26,191. "Improvements in electric switchboards." E. W. Cowan and A. Still. Dated December 12th, 1898. Switches and switchboards for central stations, for regulating transformers, &c. A series of vertical rails are bolted or otherwise secured to a wall, and serve as supports for bases or brackets carrying the bus bars. The front panels of the switchboard are hinged in a suitable V-shaped girder, supported in the rails so that they may be turned down for inspection. They are normally fixed by screws. Desk-like plates are secured to the bottom of the rails, and below are the lower panels. On the upper panels are mounted the main instruments relating to generators, and the feeders, &c., and on the desks and panels are fittings relating to the fields of the generators, to the exciters, and to the regulating appliances. In the case of alternating current switchboards, the synchronisers, &c., are mounted on the top of the board. Plug switches are shown for connecting the generator with either one of the bus bars. Below each is a voltmeter, and next a single-pole switch, preferably of the kind described in Specification No. 2,761, A.D. 1898. Below the switch is a cut-out having plug terminals, preferably of the type described in Specification No. 28,443, A.D. 1896. Certain of the spare contacts of this cut-out may be adapted for use in connecting up with the synchroniser by means of a double-pronged plug which is passed through the slots. The centre panel of the switchboard is fitted with a switch for connecting the two bus bars, and with a measuring instrument. It is also fitted with a switch for a regulating transformer, preferably of the construction described in

Specification No. 28,442, A.D. 1896. The synchronising transformers are mounted on the top, connection being made through the four legs which rest on terminals mounted on the panel. 9 claims.

26,334. "Improvements in electric switches." W. G. Ferguson and W. G. H. Stumps. Dated December 13th, 1898. The switch is formed with a narrow circular chamber of insulating material in which is placed a quantity of mercury and an insulating disc fitting closely in the chamber and mounted on a spindle. The contact terminals are exposed within the chamber. When the circuit is closed it is indicated by a pointer on the spindle, but on turning the spindle by the thumb-piece the disc displaces the mercury, so breaking the circuit. 3 claims.

26,343. "Improvements in the manufacture and production of plates or elements for secondary batteries or electrical accumulators." C. Brault. Dated December 19th, 1898. The material to be rendered active consists of a mixture of litharge with 10 per cent. of calcium sulphate, or other salt of an alkali or alkaline earth, and for negative plates 1 to 3 per cent. of the double chloride of platinum and mercury, or of platinum chloride, or of mercury sulphate, is added to the mixture, which is then kneaded up with distilled water in a vessel through which a stream of ammonia gas is passed, or the kneading is effected with a solution of ammonia. The material is then dried and pulverised. A grid having triangular-shaped cross-bars with conical projections at their intersection, is then placed in a mould and covered with the pulverised material described above, and then on this is placed a similarly shaped plate, formed with holes which fit over the projections, and the two are then forced together by pressure. The surface of the mould may be furnished with points or projections which form indents in the active material. The plate is then immersed for several hours in acidulated water, after which it is dried. The plates in the battery are separated from each other by rods of glass, celluloid, or ebonite, or perforated and corrugated sheets of ebonite or celluloid. 4 claims.

26,351. "Improvements in galvanic elements or batteries." J. Wetter. (M. Mass.) Dated December 13th, 1898. Relates to dry batteries of the Leclanché type. The zinc electrode is made with a projecting tapered tang on which the binding post is fastened by pins. The zinc electrode is also covered on its inner side with a layer of asbestos. The carbon electrode is made with one or more openings leading into a central hollow part, which is filled with the electrolyte. In the upper part of this electrode is a vertical groove in which fits a shank projecting from the binding-post, which is fastened to the electrode by wire wound around both. The upper part of the electrode, with its attachment, is then copper-plated. The absorbent and the electrolyte are enclosed in a porous bag. The battery is provided with a cover, in which is fitted a tube for the supply of the electrolyte. When not in use, a plug of bamboo or rattan is placed in the tube, and serves to permit the escape of gases. Another piece of bamboo also serves the same purpose. 2 claims.

26,371. "Improvements in the methods of, and apparatus for, controlling the mechanism of floating vessels or moving vehicles." N. Tesla. Dated December 13th, 1898. (Date under International Convention, July 1st.) Relates to means for controlling from a distance the propelling and steering mechanism of floating vessels, such as ships, and moving vehicles, such as "automobiles." The apparatus is too complicated for purposes of abridgment. 13 claims.

26,401. "Improvements in bath apparatus for treatment with electricity and medicinal substances." C. E. Schnee. Dated December 13th, 1898. Relates to improvements on the invention described in Specification No. 18,475, A.D. 1897. To secure adjustment each arm bath is pivoted upon a plate which slides laterally on a plate fixed to vertically-adjustable racks secured by a cross-bar. An insulated seat free to slide backwards and forwards, is also made adjustable vertically in a similar way. The patient being in position with his arms in the bars and his legs in the baths and an electric current may be passed through him in various ways according as it enters by one, two, or three of the baths. The course of the current may also be entered by immersing three or two limbs only. Fifty different arrangements are described in the specification. 7 claims.

26,466. "Improvements in collectors for electric tramways on the overhead conductor system." R. Ralmsford. Dated December 14th, 1898. Relates to electric railways and tramways on the overhead system. The trolley pole is pivoted on the support and works over a curve guide between the springs. The wheel runs on a bar which can slide laterally on the rollers in the forked head of the pole. 6 claims.

26,476. "Improvements in galvanic batteries." C. E. Burroughs. Dated December 14th, 1898. Relates to dry batteries which may be of the Leclanche type. The depolarising mixture is enclosed in a wrapper around which the absorbent material for the electrolyte is packed so as to be uniform in density and with a comparatively smooth, regular, and level outer face. The electrolyte is then absorbed by this material, after which the cylindrical zinc electrode, which may be made up of two or more sections, is placed around the material, and is of such a size as to compress the same. A layer of saturated absorbent material is placed in the upper part of the cell, and this is in turn covered by a fluid-proof diaphragm, a layer of dry absorbent material, a diaphragm similar to the first, and a layer of tar, wax, or the like. 10 claims.

26,484. "Improvements in electrical switches." A. Watson. Dated December 15th, 1898. The object is to dispense with the cross-pin on which the operating handles of tumbler switches work. In one form, the lower end of the tumbler lever is forked or gapped, and embraces a ridge or projection on the contact lever which thus serves as a guide and prevents lateral displacement. The spherical part of the lever is seated in an open bearing. In a modification, the tumbler lever is formed with a projection taking in a slot formed in the contact lever. In a further modification, the lever carries a grooved roller, and the tumbler lever may be flattened and work between parallel faces. 4 claims.

26,526. "A new or improved crucible for casting lead or like metals under pressure, especially applicable to the formation of secondary electric battery grids or plates." E. J. Clark. Dated December 15th, 1898. A crucible, specially suitable for casting lead grids or plates for secondary batteries, has a cylinder with a piston operated by a lever or other suitable means. When the piston is raised, the molten metal passes through orifices into the cylinder, the descent of the piston forcing the metal through gates into chills or moulds, the casting taking place under pressure. The crucible may be applied generally to the casting of lead or other metals. 4 claims.

26,527. "Improvements in regulators for electric car motors." H. H. Lake. (H. S. Maxim.) Dated December 15th, 1898. Relates to the automatic control or regulation of the motors on independently-propelled cars of an electric train. A rod on each vehicle is geared to the controller arm and is normally held in one position by the springs and piston in the cylinder secured under the vehicle. The bore at the centre of the cylinder is enlarged to permit flow of fluid, and the reduced ends check the motion. The rods are coupled throughout the train, so that forward or backward motion of any vehicle in relation to the others cuts off or increases the current by moving the controller. 4 claims.

26,604. "Improvements in telephonic or other switchboard apparatus." F. W. Francis. Dated December 16th, 1898. Relates to means for mechanically or automatically ejecting plugs from jacks in telephonic switchboards, &c. A piston is fitted within cylinder and has extension rods fitted to a collar. Compressed air is forced in through the pipe, and the collar is forced against the body of the jack, so ejecting the plug. The valve controlling the air supply may be operated electrically or mechanically by the operator or subscriber, or when the subscriber replaces the telephone. In place of compressed air, other gas or fluid may be employed. 1 claim.

26,610. "Improvements in electric arc lamps." R. E. B. Crompton and E. A. N. Peckin. Dated December 16th, 1898. Arc lamps, modified from those described in Specification No. 6,276, A.D. 1897, and applicable for direct or alternating currents, with open or enclosed arcs. The frame consists mainly of two plates connected at the middle, and carrying four tubes, two of which extend downward to carry an insulated yoke. The four tubes carry the regulating solenoids, a dash-pot, a resistance choking coil, transformer, or other attachment, and a casing. The yoke carries the arc-enclosing globe, and the lower carbon holder, which is a split socket screwing into the yoke. The outer globe is carried by a hollow bolt and a lower yoke on two rods which slide in the long tubes; the bolt is threaded internally to engage a screw carried by mica washers in a cap screwed on the lower end of the lower carbon holder. The upper carbon is supported by a clutch on a central tube connected with cores within the solenoids and carrying the piston of the dash-pot at its upper end. 3 claims.

26,619. "Improvements in telephone switchboards or switching apparatus for telephone stations." W. P. Thompson. (F. F. Ahern.) Dated December 16th, 1898. Switchboards are arranged so that the subscribers are represented on both answering and calling boards, not only by their line jacks but by subsidiary jacks forming connections between the answering or calling boards. The apparatus is described with reference to diagrams and is too complicated for purposes of abridgment. 13 claims.

26,649. "Apparatus for simultaneously actuating from one point the controlling switches of the several electrical motor cars of a train." Siemens Bros. & Co., Limited. (Siemens & Halske, Aktien Gesellschaft.) Dated December 16th, 1898. Electric locomotives and motor vehicles. Relates to means for simultaneously actuating from one point the controlling switches of the several electrical motor cars of a train. For this purpose, synchronously running auxiliary motors on each car are coupled by electro-magnetic clutches to a shaft from which the controllers are actuated, preferably through springs and a ratchet holding device so as to give them step by step motions. The shaft is driven through gearing at different speeds and directions for the on and off position, and the clutches are excited from any one of the hand switches. 2 claims.

26,703. "Improvements in primary batteries." H. T. Harrison. Dated December 17th, 1898. Relates to means for automatically feeding the electrolyte or depolariser to the cells of primary batteries. The invention is described as applied to cells, each of which is made up of two porous cells, each containing a carbon element, and of a metal element placed between the cells. The cells are closed except where the pipes for the supply of liquid enters them. The liquid is supplied through a valve to a trough divided by partitions into as many compartments as there are cells. The trough is preferably slightly tilted, or the partitions gradually diminish in height from the end where the liquid enters to the other end of the trough, in order that the cells may not be short-circuited by conduction through the liquid. The gases evolved escape through a pipe and a pressure regulating trap or tank. The supply valve is kept open by the attraction of the solenoid, which is operated by the battery current, and a shunt circuit is arranged which causes the valve to be closed when the last compartment of the trough is filled with liquid. This is effected by breaking the main circuit to the solenoid by means of the electro-magnet, which comes into action when the liquid rises in the last compartment of the trough above the contact, so as to shunt the resistance. 4 claims.

26,723. "New or improved device for indicating the frequency of an electric current or currents, the said device being applicable for signalling and indicating speeds and the like." W. E. Burnand. Dated December 17th, 1898. Relates to means for indicating the frequency of electric currents which may be applied to various purposes such as speed indicating, telegraphy, signalling, &c. The current is sent through two circuits A, B, the former of which is but slightly self-inductive, but the latter strongly so by reason of the resistance with iron core. The variations in frequency will thus affect the current in the coil but slightly, while causing that in the coil to alter considerably. The pointer or other indicator carried by an armature is thus moved over a scale. In telegraphing the pointer is replaced by a disc moving under an aperture and marked with signs; the frequency is varied by altering the length of the action portion of the contact spring on the vibrator of an induction coil. The current may act on a beam of polarised light or on a suspended mirror. When used as a speed indicator the rotating shaft is caused to send the electric impulses, say, by carrying soft-iron armatures which pass between the poles of a magnet. An air gap in the core prevents variations of tension from influencing the instrument. 4 claims.

26,738. "Improvements in conduit inspection fittings for electric wiring." T. Taylor. Dated December 19th, 1898. Relates to providing the inspection openings with flat edges on which the flat flange of a stamped metal cover can be secured with red lead, &c. Slight projections in the fitting edge of the cover may be formed during stamping to give a spring action. Corresponding recesses may also be formed in the opening of the conduit or junction box. 2 claims.

26,747. "Improvements relating to the incorporation of metallic, and other substances in paper and fabrics for the purpose of producing electrical elements therein." C. Vallot and E. Pauze. Dated December 19th, 1898. Metallic and other substances are incorporated in paper and fabrics for the purpose of producing electrical elements therein. In the case of paper the metallic substances, preferably zinc and copper, in a powdered or granular state, are sprinkled over the moist pulp by means of a suitable powder distributor. In the case of fabrics, metallic threads are woven in the ordinary way with threads of hemp, cotton, flax, silk, &c. 1 claim.

26,769. "Improvements in and relating to electrically operated clocks." H. E. Andersson. Dated December 19th, 1898. The main spring has one end attached to a drum itself frictionally attached to an arbor by a stronger spring, and has the other end attached to the first going wheel is loose in the arbor. An armature loose upon the arbor is oscillated by electro-magnets, and an attached weight, and drives the arbor in one direction by a pawl and ratchet wheel. The circuit is completed with each revolution of the escapement-wheel by contact of a pin thereon, with a strip extending from an insulated collar on the anchor arbor. Between the electro-magnet and the free-work there is a second contact-breaker consisting of a column of mercury in a tube which is divided by swivelling mica-plate, the tube and the spindle of the plate being contained in a bath of lubricant. An arm extending from the armature oscillates the mica plate by playing in a fork on the spindle. Its movement is steadied by a flyer geared to a toothed sector. Striking mechanism:—The striking rack drops upon the snail when a cam on the minute hand arbor has made a lever shift it on its own arbor, so as to be clear of a rod which is movable to put the hammer under the action of a pin wheel on the armature arbor. At the moment for striking the cam sets the lever free, and the striking rack is pushed back again, by a spring on its arbor. It consequently comes into gear with a pinion on the armature arbor, and also moves the rod for the purpose above stated, while a pin upon it completes the circuit of the electro-magnet by touching a fixed metal plate. When the rack has been turned back to its original position, the pin registers with a hole in the contact plate, but the last action of the electro-magnets is not impaired because the arm which plays in the fork of the interrupting switch keeps the circuit closed long enough by contact with a spring strip. 8 claims.

26,788. "Improvements in and relating to electrical incandescence lamps." V. I. Feeny. (Allgemeine Elektricitats Gesellschaft.) Dated December 19th, 1898. Relates to incandescent lamps. A lamp having an incandescing rod of a substance which conducts only after preliminary heating by auxiliary means as described in Specification No. 19,424, A.D. 1897, is described. A bulb, open at the bottom, is attached to a screw cap provided with a concentric conducting-ring and tube. The rod is supported by wires attached to the ring and cap. The auxiliary heater is a surrounding wire connected similarly to the ring and tube. The cap screws into a socket, which is carried by an insulator on extensions of a metal bobbin, and is connected by a winding on this bobbin with one supply wire. The ring bears against a contact connected to the other supply wire. An iron core is held by its weight or a spring against the tube, and so connects the heating wire in parallel with the rod until this is heated and conducts sufficiently to make the solenoid withdraw the core from the tube, thus breaking the circuit through the heating wire. The core also closes the tube during the preliminary heating but when withdrawn it allows passage of air up through the bulb, the tube and holes in an insulated casing, to prevent deposits on the bulb. A cross-pin limits the movement of the core if the lamp is removed from the socket. An outer globe is held up against stops on the casing, by springs thereon, so as to admit air the springs are pressed in by studs when placing the globe in position. In a modification, the springs are replaced by similarly-shaped piece of metal, which are pivoted and carry screws bearing against the casing to hold them against the globe. 7 claims.

26,790. "Current-conducting connection between electrical conductors." V. I. Feeny. (Allgemeine Elektricitats Gesellschaft.) Dated December 19th, 1898. Relates to a composition for connecting metallic conductors to bodies which are only conductors at a high temperature. A paste is made of a mixture of oxides of certain rare metals, such as zirconium, yttrium, cerium, thorium, and water, gum solution, or the like. This paste is packed round the joint and heated. The connection may also be made by coating the points of contact with solutions of the salts of the metals referred to. 2 claims.

there is much in the design that [illegible]